Railway Mechanical Engineer

Volume 99 AUGUST, 1925 No. 8

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In the SEPTEMBER issue

A study of the drill press in the railway shop

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY

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Entered at the Post Office at New York, N. Y., as mail matter of the second class.

Request for change of address should reach the New York office two weeks before the date of the issue with which it is to go into effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice. In sending us change of address, be sure to send us your old address as well as the new one.

Subscriptions, including the eight daily editions of the Railway Age published in June, in connection with the annual convention of the American Railway Association, Mechanical Division, payable in advance and postage free: United States, Canada and Mexico, $3.00 a year; foreign countries, not including daily editions of the Railway Age, $4.00. When paid through the London office, 34 Victoria Street, S. W. 1, 17s. 0d. Single copy 35 cents or 1.6d.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulation (A. B. C.).

Mechanics Fight For—Ryerson Lathes

THIS photograph shows a typical railroad shop on an Eastern Line. One of the features that makes this shop typical of railroads is the Ryerson-Conradson Engine Lathe which is used for turning wrist pins and link motion parts for locomotives. You'll find R-C Lathes in most of the railroad shops; in fact, on a Western Line a mechanic insisted upon running the R-C Lathe that had just been installed there, and he put forth his claim of seniority as a reason why *he* should run the R-C. The qualities in a R-C Lathe that make the workmen fight for a chance to run it are the very reasons why you should look into this lathe.

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Write for Bulletin 1301

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Railway Mechanical Engineer

Vol. 99 August, 1925 No. 8

When buying production machine tools

The present tendency to organize the facilities of the maintenance of equipment department with the primary objective of obtaining quantity production has led to the more general utilization of special purpose machine tools. Many of these machines are classified as distinctly special machines, but the majority of the special purpose machine tools used in railroad shops are standard types that have been equipped or converted for single-operation work. For example, there are many shops in which milling or planing machines are used solely for machining shoes and wedges; grinding machines for motion work pins, etc. In all probability an investigation would show such practices to be the rule rather than the exception. However, this development leads to a suggestion that many mechanical department officers and machine tool purchasing committees can do well to consider when about to purchase new machinery for specific jobs.

The ordinary machine tool, such as a lathe, planer or drill press is usually designed to perform a variety of jobs. Considerable extra equipment is sometimes included as part of the machine in order to make it adaptable to perform different kinds of work. However, if it is to be used for only one particular job, why buy the extra equipment? Again, there are many parts on a standard machine that could well be eliminated if it is to be used as a special purpose tool. It is in this connection that the machine tool salesman can be of real service in helping to reduce the cost if he is permitted to co-operate with the mechanical department officer or machine tool committee. Thus, instead of purchasing machine tools as equipped by the manufacturers, the railroad can purchase standard machines intended to be used on special jobs without acquiring a lot of parts which cannot be used. A saving on each machine which may amount to several hundred dollars in some cases, is well worth considering, especially if the road is placing a large order.

Getting Greater Firebox Life

One of the real problems confronting railroad mechanical departments at the present time is how to get greater life from locomotive boilers, particularly the fireboxes which are subject to the greatest temperature variations and hence expansion and contraction strains. Particularly in bad water districts, the deterioration of firebox sheets is rapid and in some cases necessitates the renewal of the entire firebox within a period of four years or perhaps less. This results in excessive cost of boiler maintenance work, both for labor and material, and possibly more serious still is the loss of the locomotive to revenue service during the period it is in the back shop for a new firebox.

In this connection the somewhat striking performance of a firebox on the Southern Pacific may be of interest. Locomotive 601, one of a lot of 10 Pacific type engines purchased from the Baldwin Locomotive Works in 1912 by the Southern Pacific Lines of Texas and Louisiana for passenger service between New Orleans, La., and Houston, Tex., was put in service in August, 1912, and, except for conditioning operations in back shop and enginehouse, has been in continuous operation since that date. The locomotive was last sent to the shop March 28, 1925, and at that time had been in service 12 years and 7 months with the original firebox, having run 1,130,880 actual miles, an average of 7,489 miles a month including the time in shop. The original firebox applied at the Baldwin Locomotive Works, was removed during March when the engine was held for general repairs.

The locomotive was in regular passenger service between New Orleans and Houston for over 10 years, and during the last two years hauled passenger trains in runs between New Orleans and San Antonio, Tex., a distance of 510 miles. The record of 1,130,880 miles run with the same firebox is unusual and indicates what can be done when proper attention is given to assure the frequent, thorough washing of locomotive boilers with hot water operation of locomotives in such a way as to minimize temperature variations under all conditions, and treatment of boiler feedwater to neutralize as far as possible its corrosive effect on firebox and other boiler sheets as well as the tubes and flues.

Accurate Costs and Business Management

In asking the Interstate Commerce Commission promptly to provide for the railroads a system of accounting which will currently and scientifically develop true costs for each primary and incidental activity in which they may engage, the seventeen representatives of the freight car repair industry who on July 14 addressed a communication to the members of the commission, have again brought into prominence a question which in one way or another has come up for discussion many times in the past. This question of cost accounting for the railroads is one with many ramifications and apparently involves a difference between the purposes of the standard form of accounts now in use by the railroads and the purposes of cost accounts which is not easy to compose. There are many difficulties in the way of a solution of this problem which will be ideal both from the standpoint of general railway accounting as well as from the standpoint of cost accounting. But it cannot be denied that there is sound reason back of the request made by the representatives of the car repair industry.

Cost accounting as it is applied in industry primarily provides the industrial executive with facts on which to

keep his production policy in proper relation to his market rather than with a means of controlling the costs themselves. Similarly, in the railroad shop, it is probable that accurate cost accounting would in most cases effect little difference in production control, for which some form of man-hour statistics are generally quite adequate. There are, however, business problems involving the policy of the railroad with respect to the purchase or manufacture of many types of material and supplies, in which costs carefully built up to include every item of overhead, such as carrying charges on the investment in buildings and equipment involved in the manufacture of the material in question, as well as superintendence and general expenses, are essential to the formulation of a sound decision. The argument that because buildings and machine tools are already available and the salaries of department and general officers must be paid, none of these items should be taken into account in figuring the cost of repairing cars and locomotives or the costs of secondary manufacturing operations, is carried too far. The fact seems to be overlooked that a blind following of this argument is likely to lead to a situation in which additions to these items become necessary because of the volume of the operations built up as a result of the fictitiously low prices at which the work can apparently be done by the railroad. Cases have been observed where in shops inadequate to meet the full demand for locomotive maintenance, building space and machine tool equipment have been devoted to whole departments actually engaged in the manufacture of machine tools for the use of the railroad, when such a policy could not possibly be justified by a comparison of costs if adequate overhead charges had been included in its own costs by the railroad. Even in the case of car repairs, the decision to make all repairs in the railroad's own shops because the expense for direct labor and material, plus shop expense, involved in doing the work in the company's own shop, is less than the contract price of the outside shop, must in the end lead to a heavy capital expenditure to provide adequate facilities to meet the maximum demand. In either of these cases it is evident that to neglect the various overhead expenses out of the calculation is fallacious.

In the interest of better business management in the establishment of equipment maintenance policies, it is evident that a compliance with the request of the representatives of the car repair industry is very much needed.

Making Better Foremen

We do not mean to imply from the title of this editorial that the foremen and supervisors in the mechanical department of American railroads have not made good. Too frequently they have been unjustly criticized. Even worse than this, foremen and supervisors who have gone to the very limit in promoting the interests of their employers, making great sacrifices of time and strength, have received not the slightest recognition or appreciation for such service. One marvels sometimes at the dogged persistence and loyalty that have characterized these men as a group, in spite of lack of recognition.

The managements, however, are in some cases open to the severest sort of censure not only because they have failed to recognize the loyalty and unselfish service of many of their foremen and supervisors, but also because they have failed to bring to the attention of these busy men the remarkable developments which have been made in recent years, in analyzing the principles of successful leadership and applying them in a scientific way. There is nothing much more spectacular or startling than the impressions made upon an average group of foremen in any industry when developments of this sort have been placed before them in a simple, understandable fashion. A notable instance of this on a railroad was the case of the Lehigh Valley foremen at the Sayre shops when they were introduced to the foremanship course developed by the Engineering Extension Department of The Pennsylvania State College. Almost as striking results have been evident when experts on management or foremanship training have appeared before other groups throughout the country either in the industries or on some of the few railroads which have attempted to face up to this problem. Incidentally some reference to a case of this kind is made in the comments elsewhere in this issue by "Output," on Bill Brown's prize article on "The Foreman and His Responsibility."

A few months ago we asked the mechanical superintendents on the different railroads for information concerning what, if anything, they were doing to promote foremanship training. The results of this investigation were summarized in the article on "Training Foremen in Leadership" which was published in our June number. One characteristic of a number of the letters received from the mechanical superintendents was the distinct request that they be fully advised of our findings—this request was so made in some cases that it indicated a real interest in the results of the study and a determination to take advantage of the good things which are being used on other railroads.

Since the publication of the article last June a number of developments have taken place which give great promise for the future in this matter of assisting the foremen and supervisors in improving their leadership ability. One mechanical superintendent, for instance, has appointed an assistant who will give his entire time to this question of training and coaching the foremen and otherwise helping to improve relations between the workers and the management. This assistant will not only receive thorough co-operation and encouragement from his immediate superior and the management in general, but will be furnished with such expert assistance as may be found desirable. Other mechanical department superintendents have indicated that they will assist the foremen and supervisors in every way possible, either through the formation of foremen's clubs for consideration of the principles underlying successful foremanship, or in the organization of study classes or other things which will be helpful to the foremen. Then, too, some of the groups which have been studying this problem have indicated a desire for information as to special topics for discussion which will assist them in carrying on their studies in a larger and more advanced way.

It is significant that several chief executives in looking over the June number of the *Railway Mechanical Engineer* specifically commented upon the first prize article on "The Foreman and His Responsibility" and the study or summary on "Training Foremen in Leadership." This should be a distinct encouragement to the mechanical department officers and foremen in going foreward with this good work. The *Railway Mechanical Engineer* is also interested in doing anything it can to be of assistance and to direct the studies and discussion along the right lines. Incidentally, in this connection we desire to direct special attention to the three rather interesting comments in this issue on the first prize article on "The Foreman and His Responsibility."

One of these comments is in the form of a very drastic criticism of Bill Brown's suggestions and philosophies. It comes from a man who apparently has very little sympathy with the modern tendency of the application of the Golden Rule to our industrial and transportation activi-

ties. We may designate him as of the "hard boiled" type, but nevertheless his attitude is that of a considerable number of foremen and supervisors in the mechanical departments of our railroads today. This must be clearly recognized and squarely faced, because the foremen are the very keystones in the mechanical department organization. This particular communication is signed "Top Sergeant" at the request of the writer of the article. Presumably he intends to reflect the so-called military attitude, although if we understand the new developments in the army of the United States, it is vastly different from that which is voiced by "Top Sergeant." Today the progressive leaders in the army apparently feel that the very highest morale can be engendered only when each man in the army is critically studied and then is so placed and developed that he can make the very best possible use of those particular talents with which he is endowed. Is it not true that the morale of a railway organization is also dependent upon helping the men to find that particular class of work for which they are best fitted and to assist them in so developing themselves that they can be of the greatest possible use and satisfaction both to themselves and the company for which they work—and in making this statement we do not mean to infer that the men should be exploited or worked beyond reasonable limits.

It will be noted that two of the comments on Bill Brown's article are in more or less agreement with Bill Brown, except that they emphasize or more fully dwell upon some of his suggestions. Closely related to these comments and forming a rather masterful discussion of the entire question of foremanship, is the presentation made by the winner of the second prize in the competition—John H. Linn, assistant supervisor of apprentices on the Santa Fe. It would be difficult to pack a greater amount of real information and inspiration on this foremanship question into so small a compass as occupied by Mr. Linn's discussion. Indeed, any group of ambitious foremen who will plan a series of discussions based on the two prize articles in this competition and the comments on Bill Brown's article in this issue, will find enough live topics to keep them going throughout an entire season.

Incidentally, we very greatly appreciate the co-operation given by those who have written to us about Bill Brown's article. The comments that we are publishing are thought-provoking and promise to be most helpful in encouraging foremen and supervisors to think this problem through to a logical conclusion. We wish we might have still more criticisms and comments. "Top Sergeant" has gone after Bill Brown in great shape, but Bill Brown is something of a fighter and years of practical experience and success as a foreman and shop superintendent have splendidly equipped him to support and back up his contentions. Could anything be more helpful to the foremen and supervisors in the mechanical department than a lively, straight-from-the-shoulder discussion of this question in our columns? We shall be glad to hear from any of our readers on either side of this question. The harder you hit, the better.

New Books

SUPERHEAT ENGINEERING DATA: *A handbook on the generation and use of superheated steam. Sixth edition, revised. Bound in keratol, 4½ in. by 7 in., 208 pages, 85 illustrations and diagrams, 69 tables. Published by the Superheater Company, New York. Price* $1.00.

This handbook contains condensed data for steam power plant engineers and operators. A feature of the book is the index consisting of 16 pages, which assures ready reference. Superheated steam, its advantages over saturated steam and the proper design and performance of superheaters, are briefly discussed. It illustrates superheater arrangements in practically all stationary, marine and locomotive type boilers commonly made in America. Waste heat, portable and separately fired superheaters are also shown. Brief comparative data is given as to sizes, tube sizes, arrangement of tubes, etc., for the stationary water tube boilers which are illustrated. The steam tables cover pressures from below atmospheric to 600 lb., absolute, and include properties of superheated steam from 50 deg. to 300 deg. F. superheat.

The section on piping includes information for figuring piping for handling water, saturated and superheated steam and velocity and pressure drop of water and steam flowing through piping. In this section is included the standard weights and pipe flanges for high pressures proposed by the American Engineering Standards Committee. This book also contains engineering data on coal and oil-fired boilers, which include tables of heat values for gaseous, liquid and solid fuels. Other miscellaneous data include complete conversion tables and data on bolts and screw threads, with the recent work of the American Engineering Standards Committee and the National Screw Thread Commission. There are also many miscellaneous tables frequently used by steam engineers.

What Our Readers Think

Minimum use of figures when setting Walschaert gear

PROCTOR, Minn.

TO THE EDITOR:

I have read with interest Mr. Sparrows' article which appeared on Page 77 on the February issue of the *Railway Mechanical Engineer* and do not feel content to sit on the side lines and let this article go by without a reply which he solicits. I agree that the fewer figures used the less liability there is for a mistake.

I will briefly outline the method of setting the Walschaert gear used on the Duluth, Missabe & Northern and approved by our officers. If the engine is to have new main crank pins they are turned and milled with the proper size key-way on the eccentric crank fit of the pin. They are then placed on a face plate shown in Fig. 1, with the two centers leveled up. We have a templet, Fig. 2, for each class of engines, *A C* being made equal to one-half of the crank pin throw, *A B* equal to the length of the eccentric crank arm and *B C* equal to one-half of the eccentric throw circles. With the side *A C* of the templet resting on the face-plate the pin is turned until the center of the pin and the center of the key-way line up with the side *A B* as shown in Fig. 1. Then with a surface gage set to the center of the pin, the line *x y* is scribed on the side of the pin at the back end. When pressing the pin in the hole, the line *x y* on the pin should register with the line *x, y,* on the wheel as shown in Fig. 3. One side of this templet is placed outward for right pins and the opposite side placed outward for left pins. Care should be taken to use it properly and it should be marked to avoid confusion.

The next operation is the setting of the crank arm to the proper throw by the use of the gage shown in Fig. 4, drill and ream the hole for the bolt and fit the key. All motion parts should be checked to see if they compare with the drawings.

The first procedure in setting valves, after getting the port marks and dead centers, is to check the suspension of

the radius bars. The reverse lever is placed so that, the link block on one side is exactly in the center of the link. This can be checked by moving the link forward and back with the eccentric rod disconnected and noting when no motion is conveyed to the valve. The other side should now be examined to see if it is exactly central which, if not, indicates that the length of the radius bar hanger must be altered. To ascertain the amount of alteration required, first tram the lifter arm from some stationary

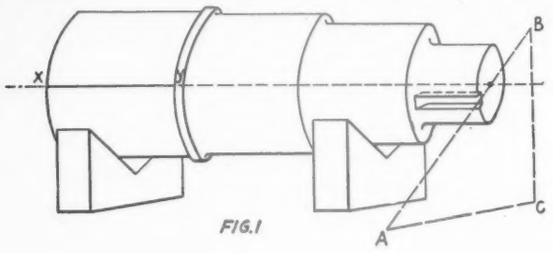


FIG. 1

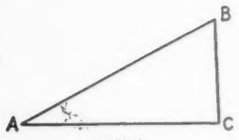


FIG. 2

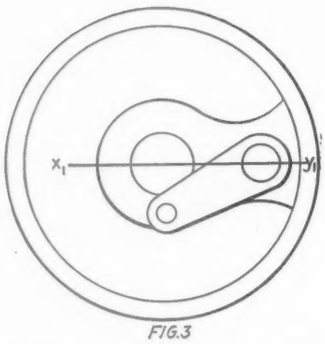


FIG. 3

Fig. 1—Crank pin placed on the face plate preparatory to laying off key-way; Fig. 2—The templet used for each class of locomotive; Fig. 3—Line X Y on the pin should register with line X_1 Y_1 on the wheel when pressing in the pin

point either directly above or directly below it then move the reverse arm until a perfectly still valve is found when rocking the link. Then tram the lifter arm again from the same point with the same tram. The distance between the two tram marks denotes the change required on one hanger in order to have both link blocks centered at the same time. Nothing else preventing, the short hanger may be lengthened this amount.

The following method is used to get the proper length of the valve stem and eccentric rod. With the reverse lever in the position that will exactly center the link blocks, revolve the main wheels and mark the extreme travel of the valve upon the valve stem. The port opening obtained at each end is the lead of the valve and if the leads are not equal the valve stem should be altered one-half the difference. We do not make a practice of changing the length of the radius bar. The change is made on the valve stem by pulling the valve out of the chamber and facing the collar or applying a faced washer between the spider and the collar as the case demands. It must be remembered that new port marks have to be taken when the valve is replaced.

Let it now be said that the valve stem is the proper length. Our attention will be now on the eccentric rod.

Placing one side of the locomotive on dead center the link should be exactly plumb and moving the link block from one end of the link to the other should not move the valve. If the valve moves, it indicates that the link is not plumb, as shown by the dotted lines in Fig. 5. The eccentric rod must be altered to make it plumb. Tram from the foot of the link to the guide yoke as at *a*, then revolve the main wheels slightly to plumb the link. (By moving the link block from one end of the link to the other, the link is known to be plumb when no motion is conveyed to the valve.) After the link is plumb tram again as at *b*. The difference between *a* and *b* is the amount necessary to alter the length of the eccentric rod. The same method applies on the other side of the locomotive.

The leads of the valves are now square. It is a known fact that the points of cut-off are not always square with the leads.

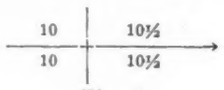


Fig. 6

If the cut-offs in the running position show up as shown in Fig. 6 it indicates a valve rod change to square up the valve. The amount of change is determined in the following manner. Return to the shortest cut-off point, in this case 10 in., from the back end of the stroke, and the tram falls in the port mark on the valve stem. Revolve the wheels until the crosshead is 10¼ in. $\left(\frac{10+10\frac{1}{2}}{2}\right)$ from the back end of the stroke and tram again on the valve stem. To square the cut-off the valve rod should be changed a sufficient amount to bring the port mark under the tram at this position.

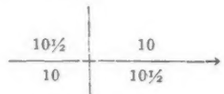


Fig. 7

If the cut-off in the running position shows up as in Fig. 7 it would be necessary to make a slight eccentric rod change to square up. The amount of change may be

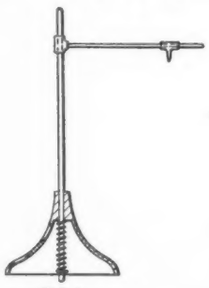


FIG. 4

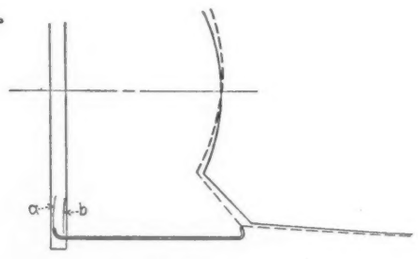


FIG. 5

Fig. 4—Gage used when setting the crank arm to the proper throw; Fig. 5—Method of training a link to make it plumb

determined in the following manner. With the reverse lever remaining in the forward position and in the same notch as when the cut-off was taken, return to the short cut-off, 10 in. from the front end of the stroke and tram from the foot of the link to the guide yoke. Revolve the wheels until the crosshead is 10¼ in. $\left(\frac{10\frac{1}{2}+10}{2}\right)$ from the front end of the stroke and tram again from the foot of the link to the guide yoke. The eccentric rod should be altered the amount between the two tram marks to square the cut-off. The last two changes, if made, will of course make a variation in the leads and one must be conservative in making changes, not go to the extremes.

T. C. GUMMERSON,
Supervisor of valve motion, D. M. & N.

The evaporative capacity of locomotive boilers

A new formula is proposed for determining the relationship between the rate of evaporation and the rate of combustion

By Alexander P. Poperev

Part I

AMONG the different problems of railway mechanical engineering yet waiting a satisfactory solution, is that of accurately predetermining the evaporative capacity of the locomotive boiler for any given set of conditions. When we take into consideration the fact that it is the boiler rather than the engine, which determines and limits the capacity of the locomotive, it will be understood why an accurate solution of this problem is so important to the railroads as well as to the locomotive builders.

The present method of handling this problem is far from being commensurate with its importance, at least as far as its accuracy is concerned. Various cut and dry rules commonly used that are derived from practice, are too general and do not go further than to give a rough idea about the usual proportionality between dimensions of the boiler and the tractive force of the locomotive. Likewise, from experience we know approximately how much steam can be produced under average conditions by the unit heating surface of the locomotive boiler. Nevertheless, with all the years of experience and knowledge, when it comes down to the question, "given a certain locomotive and fuel, how much steam can be produced at a certain rate of combustion?"—one has either to guess or run an experiment. However, it is just this question that both the railroads and the locomotive builders would like very much to have answered.

An intelligent and accurate answer to this question evidently requires the knowledge of a general law, governing the relationship between the evaporative capacity of the locomotive boiler and the various factors affecting it. Neither a theoretical nor experimental study of the question, however voluminous it may be, has as yet given a general mathematical expression of the above law. The problem is far too complicated. However, there has been accumulated a considerable amount of experimental data, which permits the study of the influence of various factors, at least the most important ones, as to the evaporative capacity of the locomotive boiler.

The writer has been interested in this question for some time and he aims in this article to discuss certain results of a personal study covering a considerable period of time. Considering the performance of the locomotive boiler to be entirely independent from the engine and subject to its own particular laws, it has been found possible, from available experimental data, to arrive at certain formulas, purporting to express the relationship between the evaporative capacity of the locomotive boiler and some of the most influential factors affecting it. The resulting expressions cover a sufficiently wide range of conditions, as much as available experimental data would permit, and are fairly accurate. In order to avoid the inconvenience of using a somewhat complicated and unwieldy resulting formula, the construction of a diagram is worked out, whereby necessary computations may be made graphically in a very simple manner.

While the suggested expressions, being dependent upon the available experimental data, are not to be considered as final ones and refer only to a certain range of conditions, it is believed that they will be of some interest to the engineering profession, as they are even at this stage of development fairly applicable in practice, and a somewhat different method of their derivation offers a wide field for further experimental study and research.

THE author of this article, Alexander P. Poperev, is a Russian engineer. For a considerable period of time he was associated with Prof. G. V. Lomonossoff as a testing and research engineer in the experimental study of locomotives for the Russian State Railways where the idea of deducing the general equation described in this article for determining the capacity of locomotives was originated. He received his education at the Polytechnical Institute at Petrograd and is also a graduate of Massachusetts Institute of Technology.

Factors determining the capacity of the boiler

Even an elementary study of the performance of the locomotive boiler shows that there are a considerable number of factors which determine its evaporative capacity. A general analysis and experimental study leads to the conclusion that the following three factors may be considered as the most important ones; namely, type and dimensions of the boiler, kind and quality of fuel, and the rate of combustion.

The effect of other factors appears to be comparatively small. For the sake of simplicity, we may, therefore, neglect them without serious error and to assume, as a first approximation, that the capacity of the locomotive boiler is determined by the above three factors only. This assumption, as we shall presently see, is sufficiently accurate for average practical purposes.

Our next problem will then consist of determining the

relationship between the capacity of the boiler and these factors and finding for it a suitable mathematical expression. As the theory is not yet sufficiently developed to derive it in a purely analytical way, we will have to derive it empirically from available experimental data. Luckily, available experimental data permits at least to a certain extent, the analysis of the influence of each factor separately and to express it by a formula. We shall begin with a study of the relationship between the capacity of the boiler and the rate of combustion.

Relationship between the capacity of the boiler and the rate of combustion

It was noticed long ago that the rate at which fuel is burned has a marked effect upon the rate at which steam is produced by the boiler, and that there exists a definite relationship between the two. For some reason difficult to understand, this most important relationship has not been given the attention it rightfully deserves, and as we shall presently see, there has not been suggested, as yet, a general formula for this relationship which could account for all the characteristic properties and be considered as correct.

In this article the evaporative capacity of the boiler is referred to as the equivalent rate of evaporation (pounds of steam, produced at and from 212 deg. F. by one sq. ft. of heating surface, per hour) as this form lends itself conveniently for comparative analysis of the performance of boilers with different characteristics. The rate of combustion is expressed in pounds of dry fuel, burned per sq. ft. of grate area per hour. If the values of the rate of evaporation Z are plotted as ordinates against the corresponding values of the rate of combustion Y as abscissae, a smooth curve will be obtained, which graphically represents the relationship between the values of Z and Y. Such curves are presented in a way of illustration in Fig. 1, and the first thing which attracts our attention is that while they refer to most diversified boilers and fuels, yet the general shape of all the curves is manifestly the same.

It has been found, by checking with all available experimental data, that curves of a similar character are invariably obtained for any kind of boiler and fuel which leads us to the conclusion, and a very important one, that the rate of evaporation varies with the rate of combustion according to some general law. Let us then see by what kind of formula we could express the relationship between these factors. We shall approach this question by analyzing a few formulas suggested by various investigators and at the same time endeavor to learn some of the characteristic properties of this important relationship.

The straight line formula

That the relationship between Z and Y cannot be correctly expressed by a straight line equation is quite evident directly from the plots. However, many investigators still believe it to be sufficiently correct, but it is perhaps worth while to show that it is not true even for rough approximation. First of all the straight line formula necessarily assumes that for any given boiler and fuel, the proportion of losses in a boiler is constant and independent of the rate of combustion. This is not true, and as we shall see later, the experiments show quite definitely that the losses increase and rather rapidly with the rate of combustion, particularly in the locomotive boiler. But the best way to show its fallacy is in a purely algebraic way. Usually this equation is quoted in the following general form:

$$Z = a + bY \qquad (1)$$

where Z and Y represent, as before, the rates of evaporation and combustion respectively, and a and b are certain positive constants for a given boiler and fuel. Now, suppose $Y = O$; we then come to an absurd conclusion, that when no fuel is burned at all, the rate of evaporation, according to this formula, is still a definite quantity equal a, which is evidently impossible.

The Dr. Goss formula

At sufficiently high rates of combustion, the Z-Y curve deviates considerably from the straight line, which plainly indicates that its equation must necessarily be of higher order than the first. Based upon his well known experiments with locomotives, Dr. Goss suggested the

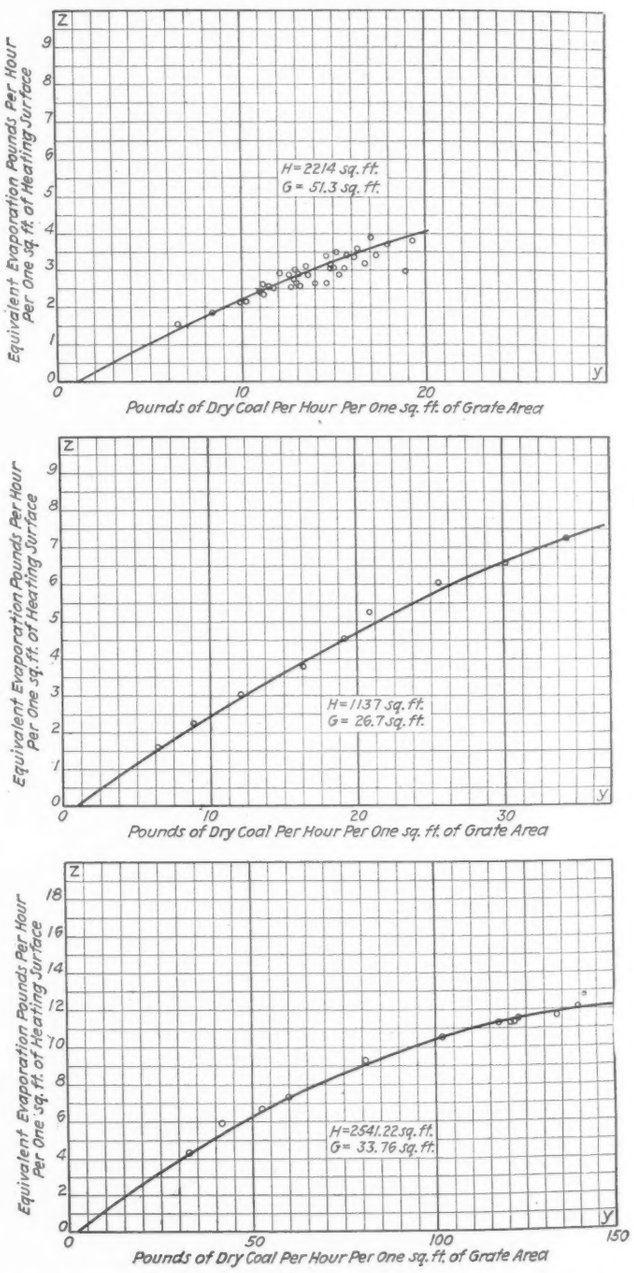

Z
Equivalent Evaporation Pounds Per Hour Per One Sq. Ft. of Heating Surface
H=2214 sq. ft.
G= 51.3 sq. ft.
Pounds of Dry Coal Per Hour Per One Sq. Ft. of Grate Area
H=1137 sq. ft.
G= 26.7 sq. ft.
H=2541.22 sq. ft.
G= 33.76 sq. ft.
y

Fig. 1—Top chart, tests made on a Babcock & Wilcox boiler at the Massachusetts Institute of Technology; Center chart, Whitman's tests on a horizontal return tubular boiler; Bottom chart, Pennsylvania Railroad Company tests on a locomotive boiler

following expression for the relationship between the capacity of a boiler and the rate of combustion.[1]

$$C = \frac{W}{a - bW} \quad (2)$$

in which

C = the total amount of fuel consumed per hour, lb.
W = the corresponding total amount of steam produced, lb.
a and b are constants.

This expression was not obtained directly, but was derived from the relationship between the evaporation per pound of fuel E, and the rate of evaporation per square foot of heating surface H. After a careful selection of corresponding experimental data, Dr. Goss assumed, that the relationship between E and H can be sufficiently correctly expressed by the linear equation

$$E = a - b_1 H \quad (3)$$

where a and b_1 are certain positive constants for a given boiler and fuel. E and H can also be expressed through

$$E = \frac{W}{C}$$

and

$$H = \frac{W}{S}$$

where S is the total amount of heating surface of the boiler.

Equation (2) was obtained by substituting in equation (3) the above values of E and H. By plotting equation (2) it was found, that although it was derived in a somewhat indirect manner, nevertheless it did fit well the values of C and W obtained directly by experiment. This fact was considered as a sufficient proof that equation (2) is correct and has been endorsed since then by other investigators[2]. However, this is not always the case, and it is possible to show that equation (2) does not represent the relationship correctly.

Rewriting equation (2) in a somewhat different manner

$$W = \frac{aC}{1 + bC} = \frac{a}{b + \frac{I}{C}} \quad (2a)$$

it can be readily seen that according to the equation, the value of W steadily increases with the rate of combustion C and reaches its limiting value $\frac{a}{b}$ at an indefinitely large value of rate of combustion, $C = \infty$. This fact is not substantiated by experiment. On the contrary, experiments show[3] quite clearly that the maximum rate of evaporation occurs at certain definite, and not indefinitely large rates of combustion and after reaching it, it has a marked tendency to decrease, notwithstanding the fact that the rate of combustion continues to increase. Such a behavior of the Z-Y curve can be readily explained by the fact, that various losses in a locomotive boiler increase very rapidly with the rate of combustion. For instance, loss due to sparks and cinders increases nearly as the square of the rate of combustion as it has been found by Dr. Goss's experiments.[4] It is evident, that at such an extensive rate of increase, the effect of this loss alone can check a further increase in the rate of evaporation and then force it down.

On the other hand, from equation (2) it follows that if $C = O$, then $W = O$ also. It would be so if we had had an ideal boiler, with no losses whatsoever; but in an actual boiler certain losses are always present, so that evaporation actually does not start until the rate of combustion reaches a certain value Y_o, usually rather small, at which the heat developed by the fuel is just enough to cover various heat losses. The value of Y_o, that is the minimum rate of combustion, necessary to keep the boiler in thermal balance, and which corresponds to a zero rate of evaporation, is very easily determined by experiment, by firing the boiler just enough to keep the pressure constant with all the steam shut off and measuring the amount of fuel consumed. Its importance for correct shaping of the Z-Y curve can be readily appreciated, and in tests made by the Russian State Railways, this experiment constituted a regular part of the test program for each locomotive.

It is also evident, that when the rate of combustion is smaller than Y_o, the heat developed by the boiler will not be sufficient to make up various heat losses; the thermal balance will be disturbed, and the boiler will cool off; in other words, at values $Y < Y_o$ we will have negative rate of evaporation. It follows, therefore, that when no fuel is burned at all, that is when $Y = O$, the correct formula for the relationship between Z and Y should give a certain negative value Z_o for the rate of evaporation which will represent the aggregate value of heat losses, when no outside heat is supplied to the boiler. We see, that equation (2) also fails to satisfy this condition. After all, the fundamental equation (3) from which equation (2) was derived, is not correct by itself. When $H = O$ from equation (3), it follows that $E = a$, which is obviously wrong. Thus we see, that from the above considerations Dr. Goss's formula fails to represent correctly the relationship between the capacity of the boiler and the rate of combustion.

Lawford H. Fry's formula

An empirical formula for the relationship between the rate of combustion was also suggested recently by Lawford H. Fry[5] which he developed in a manner similar to Dr. Goss; only in this case a linear relationship was assumed between the efficiency of the boiler F and the rate of combustion G. This relationship, according to Mr. Fry, can be expressed as follows:

$$F = m - nG \quad (4)$$

where m and n are certain constants for a given boiler and fuel. From a general definition of the efficiency of a boiler

$$\text{Efficiency} = \frac{\text{Heat utilized}}{\text{Heat consumed}} = \frac{WSk}{GRK} \times 100 = m - nG$$

he obtains

$$W = \frac{nG - nG^2}{K_o C} \quad (5)$$

where

$$C = \frac{\text{Heating surface}}{\text{Grate area}} = \frac{S}{G}$$

W = the rate of evaporation, lb. per sq. ft. of heating surface.
K = the heating value of fuel in B.t.u. per lb.
k = the heat in B.t.u. required to produce 1 lb. of steam from feed-water.

$$k_o = \frac{100}{K}$$

The above formula (5) suggested by Mr. Fry, fits the experimental data quite well, as it can be seen from diagrams, presented by Mr. Fry.[6] Besides, it accounts for the existence of a maximum rate of evaporation corresponding to a certain definite rate of combustion and from this point of view this formula is undoubtedly more correct than the one suggested by Dr. Goss.

Nevertheless, there are convincing reasons for doubting the correctness of the method, accepted by Mr. Fry,

[1] Locomotive Performance, by Dr. W. F. Goss, p. 151.
[2] Transactions, American Society of Mechanical Engineers, Volume XXII, p. 490; Proceedings, Institute of Mechanical Engineers (London) 1908, p. 269.
[3] The Engineer (London), 1920, p. 327.
[4] Engineering (London), 1913, pp. 485, 564.
[5] Engineering (London), 1921, p. 125. A Study of the Locomotive Boiler by Lawford H. Fry, p. 46.
[6] A Study of the Locomotive Boiler by Lawford H. Fry, p. 105.

for derivation of his formula and incidentally, the correctness of the formula itself. Mr. Fry does not advance any reason for the assumption of a straight line relationship between the efficiency of a boiler and the rate of combustion, except the statement that the straight line fits experimental data fairly well. But the analysis of the performance of a boiler brings us to a conclusion that the efficiency of a boiler varies with the rate of combustion according to a more complex law than the linear. We have seen that at a certain rather small value of the rate of combustion Y_0, the rate of evaporation is zero, as all the heat developed is taken up upon covering the various heat losses. The efficiency of the boiler, corresponding to this rate of combustion Y_0 is evidently zero. With the increase of the rate of combustion, the effect of the losses, which are constant and independent from the rate of combustion, that is radiation losses, leaks, etc., rapidly decreases. On the contrary, the effect of losses, proportional to the rate of combustion, rapidly increases.

At a certain value of rate of combustion these two opposing factors balance each other. The proportional loss of heat at this point will be minimum and the efficiency of the boiler will have its maximum value. In other words, the general considerations lead to a conclusion that the curve, representing the variation of the efficiency of a boiler with the rate of combustion, can not be a straight line, but must be of a higher order. The experience of Babcock & Wilcox Company[7] seems to prove that with sufficient evidence, and, on the other hand, as the writer showed some time ago, that this relationship can be satisfactorily expressed by an equation of a second order.[8] Again, the basic formula (4) contradicts the general definition of the efficiency of a boiler as quoted above. At zero rate of combustion, the efficiency of a boiler evidently can not have a maximum or any definite value. Finally, the formula (5), suggested by Mr. Fry, gives for the zero rate of combustion the value of the rate of evaporation equal to zero also, while, as we have seen, it should be negative. The above considerations seem to be sufficient to consider Mr. Fry's formula (5) and his method of derivation as also failing to express correctly the relationship between the evaporative capacity of a boiler and the rate of combustion.

Characteristic properties of the relationship between the evaporative capacity of the locomotive boiler and the rate of combustion

Let us summarize the various characteristic properties of this important relationship which we have found by analyzing different expressions for it. We have found that:

a—The general character of the curve, representng this relationship is the same for any type of boiler or kind of fuel; i.e., it is independent from both these factors.

b—It has a maximum at a certain definite, and not indefinite rate of combustion.

c—At the zero rate of combustion, the rate of evaporation is not zero, but is a certain negative quantity, equivalent to the aggregate heat losses of the boiler.

As we have seen, neither of the suggested formulas for this relationship could account for all of the enumerated characteristic properties of this relationship and for that reason, neither of them can be considered as a sufficiently correct expression of it. This failure can be largely attributed to a somewhat incorrect method of deriving these formulas; namely, from some secondary relationships, instead of utilizing original values of Z and Y, obtained directly from experiment. We hardly can agree with Mr. Fry, that such an indirect method is the best. It would be so if the secondary relationships were very simple or their properties were well known. Such is not the case and consequently the reverse method of procedure, namely finding at first a general expression of the basic relationship between Z and Y directly from original experimental data, would seem to be more rational, as then all the secondary relationships between the rate of combustion and efficiency, etc., can be derived easily in a purely algebraic way. Such a method of procedure has been adopted by the writer.

Expression suggested by the author and its analysis

Quite sometime ago,[9] the author suggested the following general formula to express the relationship between the rate of evaporation and the rate of combustion:

$$Z = -a + bY - cY^2 \qquad (6)$$

where

Z = the rate of evaporation, in pounds per sq. ft. of heating surface per hour.

Y = the rate of combustion in pounds per sq. ft. of grate area per hour.

a, b and c = co-efficients, which are constant, for a given boiler and fuel. In general they are functions of both these factors.

This expression was tried by the author on all available experimental data referring to both stationary and locomotive boilers and in every case, without exception, it was found, that formula (6) fits the experimental data in a satisfactory manner.

Let us now check its correctness by applying to it an analysis similar to the above. At the rate of combustion equal zero, $Y = O$, the rate of evaporation, according to formula (6), is negative, that is $Z = -a$. As we have seen from the above, it is one of the characteristic properties of the relationship between Z and Y and is accounted for by the suggested formula.

With the increase of the rate of combustion, the rate of evaporation steadily increases until it reaches its maximum value, which, according to the formula (6), is

$$Z_{max} = -a + \frac{b^2}{4c} \qquad (7)$$

which occurs at the rate of combustion equal to

$$Y_{z = max} = \frac{b}{2c} \qquad (8)$$

The expressions (7) and (8) are found by equating the first derivative of the formula (6) to zero and solving for Z and Y. As the coefficients b and c are always definite positive quantities, the value of $Y_{z = max}$ will be definite also.

Significance of the coefficients of the formula (6) and its graphical representation

It is interesting to note that although formula (6) is purely empirical, its terms nevertheless can be ascribed as having a definite physical significance. Let K represent the heating value of one pound of fuel and r equal the heat necessary to produce one pound of steam. If G and H will denote respectively the values of the grate area and the heating surface, then the maximum theoretically possible value of the rate of evaporation at the rate of combustion y will be

$$Z_{theor.} = \frac{KGy}{Hr}$$

For any given boiler and fuel, the coefficient b in the expression (6), as well as the ratio $\frac{KG}{Hr}$ are constants.

[7] Steam. Babcock & Wilcox Company, 35th edition, page 284.

[8] Engineering Messenger (Petrograd), 1915, No. 23. A note on the question of the relationship between the efficiency of the locomotive boiler and the rate of combustion, by A. Poperev.

[9] Engineering Messenger (Petrograd), 1915, No. 23. A note on the question of the relationship between the efficiency of the locomotive boiler and the rate of combustion by A. Poperev.

Therefore, it will be entirely correct to express the value of the coefficient b in the following manner:

$$b = \frac{KG}{Hr} - n$$

where n is a certain yet unknown constant.

Substituting this value of b into expression (6), we have:

$$\begin{aligned} Z &= -a + bY - cY^2 \\ &= -a + \left(\frac{KG}{Hr} - n\right) Y - cY^2 \\ &= \frac{KG}{Hr} Y - (a + nY + cY^2) \\ &= Z_{\text{theor.}} - Z_{\text{loss.}} \\ &= Z_{\text{theor.}} - (Z_a + Z_n + Z_c) \end{aligned}$$

The significance of the coefficients a and c of the expression (6) can thus be seen at once. They evidently

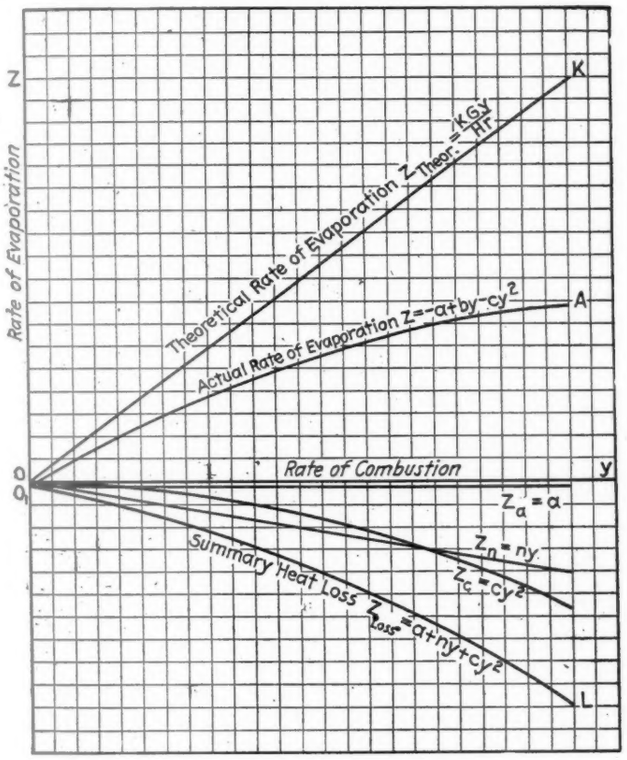


Fig. 2

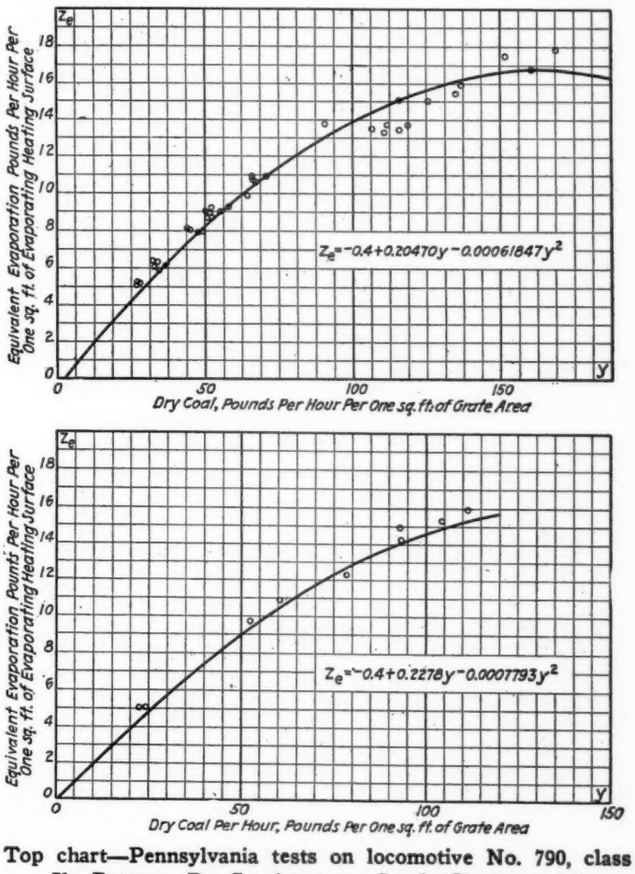
represent heat losses in the boiler, expressed in terms of rate of evaporation. The coefficient a represents the summary heat loss, which is constant and independent from the rate of combustion, while the coefficient c represents the summary heat loss, proportional to the square of the rate of combustion.

The constant n evidently represents a summary heat loss directly proportional to the rate of combustion, and therefore, the coefficient b represents the difference between the theoretical value of the rate of evaporation Z_{theor} and the equivalent heat loss, directly proportional to the rate of combustion.

The above can be conveniently represented graphically as shown in Fig. 2. By plotting values of Z_a, Z_n and Z_c we obtain three curves, each of which represents a summary heat loss, expressed in terms of the rate of evaporation, namely the summary heat loss Z_a, independent of the rate of combustion then Z_n directly proportional to the rate of combustion and finally Z_c proportional to its square. Adding the ordinates of these three curves for each value of y, we obtain the curve O_1—L, which represents graphically the total heat loss and how it varies with the rate of combustion. Subtracting the ordinates of the curve O_1—L from the corresponding ordinates of the straight line O—K which represents the maximum theoretically possible value of the rate of evaporation, we obtain the final curve O_1—A which represents the actual rate of evaporation as it is expressed by formula (6).

Fig 2 illustrates graphically that formula (6) is based on the assumption that the heat losses in a locomotive boiler can be divided into losses, independent of the rate of combustion and losses proportional to the first and second power. Unfortunately, no experimental study of the various losses in the locomotive boiler is known to the writer which would be complete and accurate enough to check numerically this assumption. However, it is quite reasonable to suppose that this assumption is very near to what actually takes place in the boiler. For instance, such heat losses, like leakage, radiation loss, etc., are obviously independent from the rate of combustion.

Again, there are no direct experimental data, which would show, which losses are directly proportional to the rate of combustion; but it is quite reasonable to assume that the loss through the grate, as well as the loss through ash and clinkers is directly proportional to the rate of combustion. On the other hand, we have direct


Z_e
Equivalent Evaporation Pounds Per Hour Per One sq. ft. of Evaporating Heating Surface
Z_e=-0.4+0.20470y-0.0006847y²
y
Dry Coal, Pounds Per Hour Per One sq. ft. of Grate Area
Z_e
Equivalent Evaporation Pounds Per Hour Per One sq. ft. of Evaporating Heating Surface
Z_e=-0.4+0.2278y-0.0007793y²
y
Dry Coal Per Hour, Pounds Per One sq. ft. of Grate Area

Top chart—Pennsylvania tests on locomotive No. 790, class Ils. Bottom—Dr. Goss' tests on Jacobs-Shuppert and radial stay boilers

experimental proof, that certain losses, like loss due to sparks and cinders are nearly proportional to the square of the rate of combustion, as it is shown by tests run at the University of Illinois[10] and at the Altoona, Pa., test plant of the Pennsylvania Railroad.[11]

[10]University of Illinois Engineering Experimental Station Bulletin No. 82.
[11]Pennsylvania Railroad Company—Test Department Bulletin No. 21, p. 43.

In summarizing our discussion of formula (6), suggested to express the relationship between the rate of evaporation and the rate of combustion, the following can be stated:

a—The suggested formula satisfactorily fits the experimental data.

b—It accounts for all of the characteristic properties of the relationship.

c—While being strictly empirical, its terms have a definite physical significance, which agrees with general considerations as well as with tests.

The above considerations seem to be of sufficient weight to consider the above formula, if not an exact one, as at least being a sufficiently accurate expression for the relationship between the rate of evaporation and the rate of combustion and to use it as a basic formula for deriving a more or less general expression for the capacity of the locomotive boiler and various secondary relationships.

(This discussion will be continued in the September issue, in which a practical application of formula (6) will be given.—EDITOR.)

"Bill Brown" started something

A hard-boiled foreman gets after him—Two other interesting and pertinent comments

OUR June Shop Equipment Number received an usually cordial and warm welcome. Comments have been received from many sources as to the practical value of several of the more important articles; an unusual number of expressions, however, concerned two of the articles which were more or less closely related. A chief executive of a southern road observes, for instance, "As you can imagine, my particular attention centers in the articles 'The Foreman and His Responsibility' and 'Training Foremen in Leadership.'"

The first of these received the prize for the best article in the *Railway Mechanical Engineer* competition on the responsibilities and opportunities of the foreman (the second prize article will be found elsewhere in this number); the second article was a round-up or study of the methods used in the mechanical departments for coaching or training the foremen and supervisors in the art of leadership and the better understanding of human relations.

Space will not permit publishing all of the worth-while comments which were received. We have selected three, however—one from an old-fashioned, hard-boiled type of foreman and two others from men who are seriously trying to think through the questions of efficient leadership and human relations in the mechanical department. These comments are published in the hope that they will stimulate further thought and discussion on the observations which were made by "Bill Brown," as well as those made by others who participated in the competition on the responsibilities and opportunities of the foreman and whose articles will appear in this and future issues of the *Railway Mechanical Engineer*.

"Bill Brown" drastically criticized

TO THE EDITOR:

Referring to the suggestion on page 322 of the June *Railway Mechanical Engineer* and the question: Do you agree with "Bill Brown" in his article on the foreman and his responsibilities.

Well, I'll start the ball rolling by saying emphatically, "NO"!!!

In the first place, I think he should have told his foreman when he joined the band that quite probably he would want to get off for a day in the near future, explaining why. Then he would have been running no chance of creating confusion in the band by finding at the last minute that he could not get away. Why should a railroad shopman play in a town band anyway? His first consideration should be looking after his job and I think his foreman was very considerate in giving him the warning he did.

Then again, if Bill Brown had been as observant as he should have been, and as possibly he has now become, he should have noticed his increase in pay, even though it was small, and should have acknowledged his appreciation with thanks to his foreman for obtaining it—which is only what common courtesy would demand. If he was working for the writer he would get no more increases through him.

The new foreman—What an easy mark Bill Brown appears to be in calling together and speaking to his men as he did. If he worked for the railroad as the writer does, he would have no opportunity to call his men together for any such purpose the second time. He would very probably, and, in my opinion, quite justly, be "canned" by our superintendent motive power as being unfit supervising material.

One may think I am hard-boiled. But is there not too much of this brotherly love stuff being preached? What does it get a foreman but presumptious imposition in most cases? Were the writer in the position of the new foreman mentioned, I would more probably say to the first guy that I found not in absolute accordance with my plans and views: "There are your instructions. Carry them out and quickly too, or the gate for yours. I'm put in here to run this department and by G——, I'm going to run it. Those who put me here think I can do it and I'm going to show them I can. And any guy here who thinks he can stall on me might just as well get packed up."

I'm sure a little rough stuff at the start will have a far greater desired effect than the Sunday School meeting Bill writes of.

He says he is assuming the foremen wish to keep their men. Why does he assume that? Who wants to keep men who are not pulling with him? Show the gate to about two of them and see how quickly the others will get into line. This is not to be done as suggested by Bill as a *last* resort, but as a very *first* one.

Keep acquainted with men's point of view—What time has he for that even if it were a desirable thing to do?

What should a real *he man* foreman care about the men's points of view? That is work for the sociologists who have nothing else to do but wonder what the other fellow is thinking about. Cartoonist Briggs frequently illustrates this.

Reading the railway journals—That may be all right for college graduates and others who are attempting to pick up the railroad mechanical trade. But what can a man who has succeeded in advancing himself to the position of foreman in a railroad shop by his own unaided efforts learn from them that he does not already know from actual experience? The writer has bundles of them not yet out of their wrappers, having no time to read them. And as for the advertising pages being an education, whoever yet saw the machine that would do all the advertising claimed for it?

Treatment of new employees—What is the employment office for? If it sends in one who can't "cut the buck," I say, "chase him" and then tell the employment manager what you want and holler until you get it. About 20 minutes is all I want to size up a man and decide if he will do.

New tools and machinery—You never get the ones you ask for anyway, so why bother? Let the purchasing department look after it. Many of the new machines are no better than some of the old ones. I believe in making the old tools last as long as possible. Just keep them in repair. Much can be accomplished in this way without always whining about new tools.

Sales engineers—There most certainly are shops where salesmen cannot enter and mine is one of them. These guys, if you listen to them, would tell you to scrap some of your best tools. They are always trying to get your goat by some wild story of how much quicker work is being done on some other road than in your own shop, but it is generally a long distance away and hard to prove. They are out to sell goods, not to look after the railway's interests. So why waste your time with them?

Conservation of material—I think the reclamation department one of the most important things in connection with a railroad shop and it should be supported by all departments. Why spend time as suggested by Bill Brown by having his men attempt to use material that should rightfully be first passed through that department. If you drop a 1-in. nut into the pit, use another and let the other go on through the process of getting into and out of the regular salvaging department. It would probably cost more to get into the pit after it than a new one would.

Relationship to the foremen of other departments—More Sunday School stuff. While I would not be delighted, as Bill says, to see the other fellow get into a hole, yet I would most certainly be delighted to have my department ahead of all the other fellows' all the time, if possible. Competition is what peps up all departments. Let the unfit get into the hole and the foreman who is habitually behind take his medicine and make room for another. Getting together and protecting the misfits will not get the organization, as a whole, anywhere. If he can only bat 100, why try to protect him? A foreman can keep quite busy looking after his own department without troubling about the others. I believe in leaving such matters for the shop superintendent or master mechanic to take care of.

Attitude toward apprentices—Well, the "Rev." Bill Brown (which is not his real name or I would not say this) in my opinion is no man for a modern railroad shop and I doubt very much if he will last long wherever he is. No wonder he did not wish his real location revealed. He is altogether too visionary. No doubt he is also an advocate of "The League of Nations." If there is any one class of shop employees that should be treated rough, I'll say it is the apprentices. Let them know from the start who is boss and what they are up against and do not permit the slightest deviation. The rougher you treat them, the better they'll like you when they are through. The picture of "Rev. Bill" surrounded by 20 of his bright boys with a 24-in. vernier in a railroad shop of today is almost overcoming. Who ever heard of a vernier in a railroad shop?

He possibly can get away with his methods for a while. But I am afraid he will eventually be out selling hymn books instead of trying to run a department in a present-day locomotive repair shop, where the routing schedule of his department, supply of materials, heavy cuts and coarse feeds are the subjects that should be uppermost in his mind.

I do not suppose you will care to publish this, but it is at least an acceptance of your suggestion and the way the writer views your first prize article; I am wondering just what some of the others were like, since it got first place. Possibly it was the only entry.

"TOP SERGEANT."

A follow-up on "Bill Brown"

TO THE EDITOR:

Bill Brown said a mouthful!

This, therefore, is not a criticism of his article but rather to augment it. Brown of necessity had to cover a large territory in a few words and naturally could not stress any particular points.

As an ex-supervisor, the responsibilities of the foreman, his location in the organization and his duties always impressed me greatly.

It has been truthfully said that the foreman is the key man in industry. On his resourcefulness depends: Production, costs, co-operation of employees, and interpretation of the policy of the company.

The foreman who can get the maximum production at the minimum cost has the co-operation of the employees and it is obvious is correctly interpreting the business policy.

No amount of assistance from those higher up can or should relieve the foreman of responsibility for the four cardinal points above mentioned. He must synchronize his men, his machinery and his materials; he must have a clear understanding of the problems confronting his men and a definite knowledge of the sound principles and methods of industry. Upon his training, or lack of it, depends the success of his department and as his department is an important unit in the entire organization, the success of the railroad is likewise enhanced or jeopardized.

Keeping posted

That part of Bill Brown's article pertaining to keeping posted is well taken. The greatest problem the foreman is up against is to keep up-to-date. The various railroad magazines and correspondence schools are excellent medium of information and every foreman should be encouraged to study.

It would indeed be Utopia if foremen were given a day off now and then to visit another shop, but what road makes a practice of this? The general foreman, master

mechanic and shop superintendent have this opportunity in their membership in various railroad associations, but the ambitious shop or gang foreman does not, as a rule, have this chance. He must study to gain additional knowledge and unless he is more or less of a student he does not progress very far. Unfortunately the average foreman does not avail himself of the opportunity of study and as a result "carries on" in a manner almost identical to his predecessor which does not make for progress in the railway industry.

Another opportunity of gaining information which is seldom granted the shop foreman is to talk to the salesmen or as "Bill" calls them, the sales engineers. The master mechanic will invariably prohibit the salesman from entering the shop and talking to the foreman and perhaps the sales people are responsible. If, upon being granted permission to talk to the foreman, they would confine themselves to business, there is no question but what the interview would be of mutual advantage to all concerned.

The writer heartily suggests that one of the best mediums of gaining information is for the foreman to join some railway club. An excellent paper is read at each meeting and in addition to this he will have the opportunity of meeting foremen who are employed on other roads.

At a recent regular monthly meeting of the Western Railway Club there were over 400 railroaders and railway supply men present.

So much for keeping posted!

Sizing up men

A foreman, to be highly successful, must be a judge of human nature. Brown suggests that upon promotion the new foreman should call his men together and assure them of his co-operation and request their hearty co-operation. Splendid, but for various reasons, as stated by Brown, such as jealousy over the success of others, there will be one or two men of the gang who will say "bunk" and unless immediately curbed, will and can do considerable damage to the production program. These "kickers," frequently the best men in the gang, can be lined up, if the foreman is a good judge of human nature.

One type can be handled by approbation. Slap him on the back, tell him what a good fellow he is and instead of orders, suggest, and before long this fellow will believe the boss is a "regular guy."

A second type delivers best by constant hammering. The new boss must get this fellow to one side and very frankly say: "Jim, you are not working with me. Without your co-operation the department will fall behind and if it falls behind, one of us is going to get fired and my being the boss, it goes without saying who that one will be." I'll bet Bill Brown has bumped into that type and has handled him in a manner somewhat similar to the one just referred to.

A good foreman knows that each individual has his distinct characteristics, his peculiar likes and dislikes and he has the good sense and common courtesy to treat each man as an individual. He knows that each person has emotions, instinct and temperament and that the best results can be obtained by applying individual treatment to each man under his jurisdiction.

Do not employ a man by sizing up the clothes he wears or his manner of speech. Size him up as a potential supervisor and if in your opinion he can qualify, put him to work.

Do not be afraid of your man getting your job. By his strength and ability to perform, your own job is strengthened and your opportunities of advancement are enhanced.

If there is a more pitiful sight than the man who is always afraid some one is going to get his job, I'd like to know it.

Interpreting company policies

Bill missed a point which I shall designate "interpretation of policy of the company." The difference in operation of a railroad shop and that of a manufacturing plant, insofar as policy is concerned, has always struck me forcibly. In the manufacturing game we know the whys and wherefores. An order is usually supplemented by an explanation of the reasons. The railroad game is of a military form so far as orders are concerned, the big idea being "do it and ask no questions." This operates adversely in two ways. The foreman, without a proper understanding as to the reasons for a certain move, usually becomes militant and balky on the one hand, and, on the other, he loses initiative and feels that a suggestion on his part is decidedly out of place.

The point I am trying to make is that the foreman becomes a mere automaton and performs without consciousness.

Along this line of thought, it is my belief that the foreman should at all times be aware of the reasons for a drastic change in policy. Is it because business is poor that he must cut off his men and use scrap and second-hand material, or is it because a surplus is desired that a general plan of economy may be established?

What a mistake costs

And another thought! The foreman is not taught to think in money terms, as he should be. He should know that instead of Jim Jones spoiling a driving brass by improper machining and treating this as an article, Jim has cost the company so much in labor and material. This thought should permeate all through the railroad. Instead of saying to a car inspector: "Sam, you let XYZ-6000 get by with a defective carrier iron and she dropped a drawbar at Grand Junction causing a derailment," you should say: "Sam, do you know that through your failure to detect a defective carrier iron on XYZ-6000 you have cost the company $375?" Money means something to everyone and if he can get your point of view—that by carelessness he caused a damage equal to two month's pay—you surely have gained a point!

If a machine-hand realized that the machine he was operating cost several thousands of dollars, don't you believe he would treat it better!

If a pipe man realized that by scrapping a valve the company stood a loss of eight or ten dollars and that he could repair this valve in one-half hour, he certainly would stop and think?

All of which leads to the point that the master mechanic should equip his supervisors with price lists on all materials and equipment in order that they may have a better idea as to where money may be saved.

An industrial authority has stated that sixty per cent of strikes are due to bad foremanship. This does not apply to the railroads, but there is no doubt but what the foreman could engender a closer relationship between employer and employee if he were fully aware of the "Why and wherefore."

There was a time when the title of foreman was sufficient to command obedience and respect. The foreman of today must prove himself worthy and capable of leadership, in thought as well as in deed.

An Ex-Railroad Supervisor.

Supports "Bill Brown" arguments

TO THE EDITOR:

Bill Brown in his prize article on "The Foreman and his Responsibility" commences by quoting two of his experiences as a mechanic. Not as a rebuttal, but in a spirit of fairness, I want to tell you something of my experiences as a foreman.

Bill Smith, erecting foreman, wanted a steam chest cover planed for clearance, explaining that he wanted to get the engine off his hands because it was blocking the schedule. Also he was short-handed through absentees and I could plane it quicker than he could set up the pressure plate. I agreed with him since we had more to lose by delaying, and so he sent it over to the planer. Shortly afterward Bill Smith came back and the following conversation took place:

"Have you no authority over your men?" he said. "Jack Jones says he will not plane that cover."

"Well! There must be some mistake. I will go over and see about it."

"Say, Jack," I said, "put this cover up and plane it. It is the only job holding the engine."

"Nothing doing on that job!"

"What is the matter? This cover has to be planed and this is the best machine for doing it."

"All right. But it won't be planed by me. If I have to be fired, it will be for not doing it, as Mr. S——, the master mechanic, told me he would fire me if I planed any more."

This was the first intimation the writer had of a hard-and-fast rule against this practice.

Another time I had occasion to criticize one of the men for neglecting part of his work. The man did not take kindly to this criticism and went to the master mechanic with his grievance, to which the writer did not object in the least.

The following conversation afterwards took place between the master mechanic and writer:

"Did you fire Jack Jones?" said the master mechanic.

"No, sir. I did not."

"All right then. I thought that if you had I would try to place him in another department."

This, too, without an investigation.

What I am trying to tell Bill Brown by these experiences is that to make a foreman realize his responsibility, he must first be given that authority that makes him responsible.

Keeping posted on railroad affairs—I don't believe a foreman in these days of industrial progress can hold his job very long without reading one or more of our mechanical journals, but I don't altogether agree with Bill Brown when he says it is up to a foreman to explain why short hours are necessary, and also about the operating ratios, taxation, rates, etc. Too often, out of a clear sky, a notice is posted in the shop or roundhouse calling for a reduction of hours without any explanation at all. In these days of shop committees, the necessity for this should be explained to them, or the posted notice be made explanatory. Some of our larger railroads are now publishing weekly or monthly magazines. It would make good reading if this information was published in such magazines or bulletins.

Treatment of new employees—Bill Brown has opened up lots of room for thought in his comments on this subject. Too many of us look on a man as a means of production alone, forgetting altogether the human side. I well remember a certain foreman going after a machine man for not turning out as many pieces as he did the day before. That man's wife had that day been taken to the hospital for a serious operation (later she died), and although he knew he should not have been at work, he could not afford financially to lay off. That one instance alone taught me that it did not hurt me one bit to be sociable and that I would not lose any so-called prestige by inquiring about a man's family; in other words, showing that I was interested in other things besides production.

A new man should be made acquainted with his job, and if his job is running a machine, he should be given all the information at the disposal of the foreman about maintenance, production, etc. Pictures, set-ups and time studies can usually be had for the asking from the machine makers or salesmen. Too often we find this literature locked up in the foreman's desk. The writer believes in specialization. Train a man to be efficient in the work allotted to him. Explain what delays mean through underproduction or slack work. Make him feel that that part of the locomotive or car on which he is working is his responsibility and if the part fails, we all fail. In other words, sell him his job.

New machinery—A foreman should be, at any time prepared to show what saving he can make by the installation of new machinery or tools. Sometimes we have difficulty with a job that is only repeated occasionally; on looking through a mechanical journal, we may find that a manufacturer has a machine or device on the market for this work. Naturally, we want it and are apt to lose sight of the fact that the interest on the money spent for this device would more than pay for the time lost by the method now in use.

Foreman's relationship to other departments—Bill Brown's comments on this subject surely hit the spot. The opportunities for the display of inter-department teamwork are truly unlimited. The writer has attended foremen's meetings and noticed the satisfied look on some faces, knowing that their particular department is up to schedule and seemingly not interested in the least in the other fellow being behind. The success of the whole shop or division depends on the weakest link. Your own department may be 100 per cent, but if the rest are only 50 per cent, that will be your shop's rating.

A closer relationship between foremen socially would be beneficial, no matter if it be through organization or arrangement. Representatives of the management can assist greatly in this by attending the meetings, thereby showing that their interest is not confined solely to output. They could also arrange for talks from equipment salesmen, safety men, etc. Roundhouse and backshop foremen should both attend the same meetings. A little friendly discussion of their habitual differences does more good than a lot of letters from the master mechanic and also leaves a better taste in the mouth. If we cannot co-operate among ourselves, how can we expect it from our men?

Times and conditions are changing the relationship between foremen and men so fast that it is difficult for a foreman, trained along the old lines, to change his methods and to realize that maximum service does not depend on him alone, but on the co-operation of every man under him. Let the officers boost the foreman's clubs and organizations by attending themselves or supplying a speaker once in a while to speak at some of the meetings.

A year or so ago one of our large universities sent out a man to deliver a series of lectures to foremen in the city I happened to be in. These lectures opened up an entirely new line of procedure in the handling of men and I

am sure that all foremen that attended derived great benefit from them.

Attitude toward apprentices—I am going to make a broad statement and say that in a modern railroad shop, of say 200 or more men, an apprentice has no place unless a competent instructor is employed. It is not fair to the apprentice or to the foreman to expect him to take an untrained boy and make a mechanic out of him. In the shop where the writer served his apprenticeship, each boy was examined every month as to his ability in the department he was working in and was kept there until fully competent, there being no set length of time in any department. As an inducement to learn and to get through each department quickly, he was given a show in the tool room or on special work and, when possible, given the place of a gang boss. I would like to ask Bill Brown if he happened to have a rush of work and had an apprentice fully competent to handle his share of it, would he transfer him and train another or keep him until the rush was over?

Responsibilities to officers and men—A foreman should never lose sight of the fact that his are the eyes through which the officers see his men and through the same eyes the men see the officers. A foreman, to a certain extent, stands to his men in the same light as a father to his sons. He cannot afford to lose their respect. A slip on his part often results in the loss of morale of his whole department.

In all cases, apply the Golden Rule and your whole department will benefit. "OUTPUT."

The foreman and his responsibility

Second prize article* in the competition held by the Railway Mechanical Engineer

By John H. Linn

Assistant supervisor of apprentices, Atchison, Topeka & Santa Fe

THE foreman occupies a strategic position in a railway organization. He has a vital part in the cost of production and of operation and in building up a loyal, efficient organization. He is responsible not only for the proper care and maximum output of the mechanical equipment of his shop, but also for the placement and maximum effort of each man in his charge and for the proper correlation of the work of the various gangs so as to produce the highest efficiency of the department as a whole. Upon his shoulders rests the responsibility not only for the immediate output of his department but also for the building up of an organization which will determine the output in years to come.

The foreman is the connecting link between the management and the men. He is the representative with whom the rank-and-file come in closest contact. He embodies to them the corporation. He is the company's man. If he is fair and considerate and his example such as to command their respect, it will be easy to create in the men a feeling of loyalty toward the company and of willing co-operation with the management as a whole. But if he is grouchy or ill-tempered or self-centered, or guilty of showing undeserved favoritism, the ill feeling engendered will in all probability extend to the corporation which he represents. The foreman, being in direct contact with the men, is the interpreter of company policies. As such he has a great opportunity for instilling loyalty in the men and for building up the desired morale among the working forces, without which efficient results cannot be secured.

Essentials of successful management

The five essential factors in modern industrial management, whether in railway management or in other industries, are money, materials, machinery, methods, and men. The foreman enters into every one of these factors and is vitally responsible for the solution of the problems involved in each.

Although not directly called upon to provide the capital with which to finance the plant, the foreman in any industry is largely responsible for the amount of money needed, and the ease with which it is secured. If he is wasteful and extravagant, more money will be needed. If the output of his shop is insufficient, it will be difficult to raise the necessary funds to keep the shop going or to enlarge its operations.

The financial responsibilities of the foreman are even more apparent in a railway shop than in an industrial plant. The public is demanding not only more efficient transportation but also that the cost of transportation be lowered. Freight rates cannot be lowered unless costs are reduced. There can be no reduction in cost of materials or needed facilities; neither is it desired to reduce wages. There remains but one solution, and that is to increase the efficiency of the railroad organization and thereby lessen the cost of operation and of maintenance. This cannot be done without the co-operation of the railway foremen. Upon their capacity for organizing their forces, their ability to obtain maximum output from the men in their charge, depends the solution of this problem.

Materials and machinery

Closely related to this heavy responsibility resting upon the shoulders of the railway foreman, is his responsibility for the materials and machinery used in his shop or department. The successful foreman must know the quality of the material he uses, the purpose for which it is to be used, and its fitness for that particular purpose. He must be familiar with the cost of materials and equipment—the original cost, the cost of storing and handling, the cost of deterioration due to exposure, the cost of breakage and of spoiled work, the cost of using more material than the job requires, of using expensive material when an inferior grade would answer, and of the false economy of using inferior material when a better grade is demanded,

*The First Prize Article was published in the June issue, page 360. Criticisms and comments on it will be found elsewhere in this number.

the cost of surplus material becoming obsolete, the cost of his lack of foresight in not having material on hand when needed, the cost of handling materials and the added cost of inefficient methods of handling. The foreman has a great responsibility in keeping all such costs to the minimum. He must know, too, the cost of power, the cost of installation, operation, and maintenance. He should understand the operating cost—when it is advisable to speed up and when to slow down on the time of operation. The foreman is in a large measure responsible for the cost of operation. This cost is largely affected by his ability to handle questions of repairs and replacements, by machines being overloaded or underloaded, of being run too fast or too slow, by machines being idle, by the work of one machine being held up awaiting the output of another machine or department.

As to planning the work

Too much cannot be said about the foreman's responsibility for so planning his work and so co-operating with other departments as to produce maximum output for the department as a whole. The successful foreman must keep in touch with improvements constantly being made in equipment and must make full use of modern up-to-date machines and mechanical devices. He must be aware of the cost of obsolete equipment and of poor layout of equipment, of machines not being conveniently arranged, or of insufficient working space or of certain kinds of work being too widely scattered. His mistakes, whether of commission or omission, are indeed most costly to the railroad.

He is largely responsible for the methods used in his shop. He must know what methods to use, when to use them and how to adapt these methods to the needs of his shop and to the men. It is not the purpose of this article to discuss any particular method; suffice it to say that the foreman has a great responsibility and a great opportunity in deciding on what methods should be used in his department.

Foreman's greatest responsibility

We have mentioned briefly the foreman's financial responsibility, his responsibility in connection with materials, machinery, and methods, but it is in his relationship to his men that his greatest responsibility lies. The amount paid for labor is the biggest bill the railroads have to pay. No part of a foreman's duties are more important than that relating to the human element. No official of a railway organization has more to do with the man-power of the organization than does the foreman, from whom the men take their orders, receive their instructions, and learn of the aims and purposes of the management. No field of railroading offers greater opportunity for effective results than that relating to the man problem. Herein lies the foreman's greatest and most far reaching responsibility and opportunity. As Herbert Hoover says in speaking of our railways "We have devoted ourselves for many years to the intensive improvement of machinery and processes of production. We have neglected the broader, human development and satisfactions of life of employees that lead to greater ability, creative interest and co-operation in production. It is in the stimulation of these values that we can lift industry to its highest state of productivity, that we can place the human factor upon the plane of perfection reached by our mechanical processes." It is upon the shoulders of the foreman that the greatest part of this responsibility must be placed.

There must be greater care in the selection, placement, and training of workmen. In railroading, as in other lines of industry, more systematic methods must be employed to improve skill and to prevent men of talent from being sidetracked in blind alleys, to prevent incompetent, untrained men from being placed in responsible positions; in brief, to prevent the deplorable, and to a large extent, preventable waste, due to human inefficiency. Except where a well-organized training department has been provided, this responsibility rests almost wholly with the foreman. He it is who selects the men; he it is who places them in the shop and assigns their work. From him they receive their instructions and training and promotion. Even where a well-organized training department exists, much of the success accomplished is due to the co-operation and assistance from the foremen of that department.

The foreman must not only "know his stuff" but must know how to impart his knowledge to others. He is, after all, a teacher, a general. He must be a student of nature, must know how to lead and guide others, how to administer discipline, and how to inspire enthusiasm and whole-hearted co-operation. It is well that the foreman have skill in the work of the men he is to supervise. Others may "pass the buck" and depend on some one else for information needed, but the foreman must know whereof he speaks. He must be able to show by example how the job should be done. Having been through the mill and regular grind himself he can better sympathize with his men and understand their problems. Being a first-class workman, able to deliver the goods himself, he can better command respect and obedience from the men in his charge, can more intelligently issue orders and offer suggestions as to methods of performing work, and can intelligently pass judgment as to quality and quantity of work performed. Truly the foreman possesses unlimited responsibility. But more important than the responsibility placed upon the foreman in the requirement that he have knowledge of the work he supervises is the responsibility resting upon him in knowing how to keep the work moving from the rough to the finished job, and the responsibility resting upon him in properly managing the men who are under him.

The wrong kind of foreman

Nothing is worse for a company, nor the men employed by it, than unrestrained power in the hands of a passionate, narrow-minded man. A foreman with a quick temper and a sharp tongue who thinks more of showing his authority than of getting the work out, who makes no effort to keep his men satisfied or to inspire them to the best that is in them, can sow more discord in a minute than the most diplomatic manager can eradicate in a year. An incompetent foreman keeps the shop in a turmoil and the workmen irritated. Not knowing how to keep the work going systematically, he complains and scatters blame around when he alone is the culprit.

No matter what a foreman's other qualifications may be, his influence will be bad if he is not honest, courteous, considerate, and of good habits. In disciplining, a foreman must never forget that his men are human beings with just as much self-respect, as much pride, as much manhood, and as much "touchiness" as he himself possesses. To be placed in a position to pass judgment or administer discipline gives one no right to do it harshly. Workmen know when there is kindness behind the discipline meted out to them. A reprimand may make or sour a man. A merited calling down, administered in the right spirit will be far more effective than an ill-tempered "bawling out."

After all, as was said by the late President Smith of the New York Central: "It is not the powerful modern steam locomotives, or the still more powerful electric motors, or the endless chains of freight and passenger cars, or the well-appointed terminals, or the solidly laid tracks, or the intricate signal system; it is not all this elab-

orate net-work of equipment that makes the railroad wheels go around 24 hours of every day of the year, it is the human heart beat. Unless the great majority of those constituting the organization are working in harmony and working heartily, the results can only be disappointing."

It is the duty of the foreman to bring about this harmony of effort on the part of his men. Without this co-operation, maximum results cannot be achieved. Again we repeat, the responsibility resting with the foreman is exceedingly great.

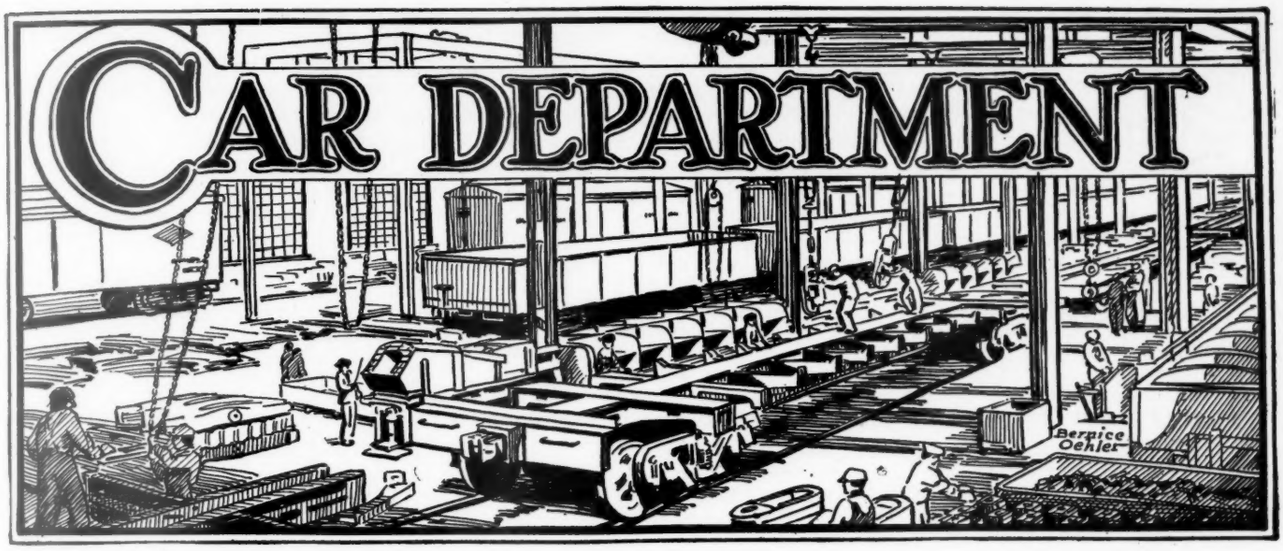
Have an understudy

One other responsibility resting with the foreman should be mentioned and that is his responsibility for having someone under him trained and ready to take his place. He should take a competent, carefully selected man under his wing and personally train him to follow in his footsteps, giving him the benefit of his experience and giving him a chance as opportunity offers to try out and develop his ability, not only in the absence of the regular foreman, but at other times when the successful foreman is at hand to note and correct his mistakes, giving him an opportunity to profit by the lessons others have learned but leaving him sufficient freedom to use his own originality and initiative. A foreman who is so narrow minded and selfish that he is unwilling to give an understudy full opportunity for development, fearful that he himself may be surpassed in promotions, is himself unworthy of promotion and the sooner he is relegated to the discard, the better for all concerned. If each foreman will see to it that he has someone ready to take his place, the problem of securing competent supervision, which causes trouble in many shops, will be solved.

We repeat, the foreman occupies a strategic place in a railway organization. Upon his success or failure the whole organization depends. They are the men who get results. From them, the future executives of the railway will be chosen. Upon their shoulders rest the output and loyalty of the rank-and-file. To their sympathy and understanding of their men and their everyday problems, their understanding of and ability to carry out the aims and policies of the management, their ability to produce immediate output and to build for the future, the efficiency of our transportation system must be attributed. Truly a railway foreman has a great responsibility and a great opportunity.

Illinois Central rules for storing coal.—The Illinois Central has issued rules governing the unloading and caring for storage coal. The ground upon which coal is to be stored must be firm, level, clean and properly drained, although no drainage should pass through or under the storage coal piles. Coal, which is unloaded into storage should not be placed on loose cinders, against wooden posts, wooden trestle bents or hot or warm pipes or flues; nor should it be placed in piles to exceed 12 ft. in height and 36 ft. in width at ground level, with the piles limited to 1,500 tons, and spaced with intervening distances of at least 5 ft. The piles must not be ventilated by artificial methods. Coal of different sizes should be placed in separate units and this same practice of segregation holds true when unloading coal of same size from different mines. Coal should not be dropped from the grab buckets more than 3 ft. The coal should not be moved after once being placed in storage, unless absolutely necessary. The temperature of the coal should be taken at least once each week, and oftener if possible, using either the thermometer or rod method; and when coal is stored under cover, the structure should be well ventilated to afford outlet for gases. Under no circumstances should water be applied to a heated coal pile. Heated or burning coal should be removed and used, or extinguished by scattering and then applying water.

The air brake rack at Purdue University comprises equipment for two locomotives and 148 freight cars—A chronograph for recording the time of application of the brakes is also included in this equipment.



How to stop hot box epidemics*

Regular reports will show where the trouble originates and a personal investigation of causes should follow

By A. M. Orr
Bessemer & Lake Erie, Greenville, Pa.

IN discussing the problem, "How to stop hot box epidemics," it will be assumed that proper material has been supplied to the oiling and repair forces, and that they have been so trained that the hot box record has been satisfactory in the past. This being assumed, it is unnecessary to discuss any of the details of the proper handling of packing and oiling.

The problem seems to divide itself into the following minor problems:

1—How are we to know that a hot box epidemic is upon us?
2—What is the probable cause?
3—What repair point or division is responsible?
4—What action is necessary?

It is probable that on every road there is a system of reporting a car which has been set out of a train before reaching its destination. That report is made, as a rule, by wire to the chief dispatcher. If the report does not already contain that information, it will be easy to change it to show the point where the car was picked up, and the fact that it has been set off for a hot box. A copy of each of these defective car reports should be furnished to the master car builder daily. In his office the reports should be classified as to the point of origin of the car. When reports come to the master car builder's desk, he will be able to tell at a glance whether any repair point is chargeable with more than its usual number of hot boxes. Thus, immediate knowledge is furnished to the head of the department concerned of any increase in hot boxes.

It is not worth while to try to itemize the probable causes of hot box epidemics, for they will be precisely the same causes which are daily causing individual cases. There are, however, certain general suggestions which can be made. If there is a sudden jump in the number of hot boxes on the morning report, and if those hot boxes all come from one station or district, it is probable that the trouble is a local one. More especially will this inference be true if the increase in hot boxes has been gradual, and chargeable to one station or district. If, on the contrary, the increase is relatively sudden and all, or nearly all stations are involved, then the cause is not local. Keeping this subdivision in mind, it is sometimes possible to determine very quickly what the trouble is.

Should the trouble be general, and in the fall or spring of the year, one may stop the trouble in 36 hours by arranging for a supply of oil which suits the weather conditions, a cause not always given as much attention as it should have. Or perhaps a visit to the stores department waste storage may disclose a supply of waste which has not the necessary capillarity.

If, on the contrary, the attack is very sudden and very sharply defined as to origin, one may by inquiry find that a lot of foreign cars have come on the road for loading, or that some home cars which have been stored for a long time have been moved forward for loading without having been given preliminary attention to insure that the journal packing is in good condition.

As a general rule if the increase is relatively slow and local, look for disorganization of repair force or local trouble with material; if the increase is sudden and wide spread, look for a special trouble, first of all in quality and handling of oil, waste and bearings.

If the report already suggested has been kept up daily, there is an immediate answer to the question "What repair point is responsible?" if the increase is sudden and local, but hot box epidemics which come from poor material may be several weeks developing. This will be true, for example if the quality of journal bearings fur-

*A paper submitted in the competition on hot box prevention.

nished has changed for the worse. It may be several months before the full effect of such a change will be manifest.

It is desirable, therefore, to have a historical report which will cover considerable periods of time. One such report may be made weekly in the simplest possible form. It is not to locate responsibility, it is only to point out tendencies. If for example, a report is made which shows weekly the number of hot boxes on east and west bound traffic, or on traffic from certain special loading districts, that report will call attention in a general way to general increases which might be overlooked on the daily reports because of the gradual increase.

The real historical report should be monthly, and it should go into details. It is desirable, first of all to know how many hot boxes caused real trouble; that is, caused cars to be set off en route. It is these hot boxes that block the tracks to traffic while the cars are being set off and being picked up, that are responsible for the breaking of couplers while heavy trains are trying to shove a car into a siding and that cause large expense for repairmen who have to go out on the road to repair them at non-repair points.

It is also desirable that these hot boxes be accumulated monthly as to responsible stations, so that the tendencies at those individual stations may be observed in a general way. A repair point may gradually crawl up from 10 or 12 hot boxes per month to many times that number without attracting special attention on the daily reports. The monthly report shows that increase clearly.

If the report includes also a statement covering not only the hot boxes set out en route but also those found at terminals, there will be an additional measuring stick which will show general tendencies. If such a report is made, it is important that the master car builder or his travelling car inspector shall, by personal instruction, make sure that all repair points are using the same method for determining what a hot box is, for if there is not such a general practice, some stations may be reporting as hot boxes some which others would not. It is not usually practicable to determine the point of origin of hot boxes on cars which are carried through to a terminal, nor is it really necessary, for experience shows that the relative mileage based on cars set out, and the mileage based on total hot boxes will not vary more than perhaps 10 per cent, unless the transportation department has taken a special interest in the hot box question and has managed to get the conductors interested in taking cars through to terminals rather than to set them off. Such special attention, while the new standard of mileage is being established by the conductors will throw the relative values off for a while.

One road, by working steadily with the train masters, was able to get conductors interested in applying grease to hot journals, looking after them in a general way while waiting at meeting points until the mileage per car set off increased from 8,702 miles to 39,073 miles four years later.

It is because of the possibility of such fluctuations that it is best to use the total hot box record as an indicator. The actual figure used will, of course, be some function of service. The loaded car mileage is desirable in some ways, for it is most productive of hot boxes, but it is well generally to use the total transportation freight car mileage.

That figure will vary on different roads. A road of light equipment may show a high mileage per hot box while a road of high speed heavy traffic may show a low

East and West Railroad
Statement of cars set out of trains
en route for hot boxes
Year 1923

Station at which car originated		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
A		22	12	31	26	53	112	131	124	66	60	37	29	703
B		..	..	..	..	..	..	..	..	..	..	1	..	1
C		2	..	1	1	1	..	..	..	..	1	..	1	7
D		3	3	1	4	4	2	1	2	1	1	2	1	25
E		4	..	..	..	..	1	..	..	..	..	..	1	6
F		9	5	13	9	11	3	9	4	4	6	4	8	86
G		11	12	14	19	18	5	12	10	7	8	7	4	127
H		69	67	106	98	126	124	112	109	84	47	62	33	1037
Total cars	1923	120	99	166	157	213	247	286	249	162	123	113	77	1991
Total cars	1922	24	28	47	39	16	130	217	169	315	191	123	103	1402
Miles per car set out	1923	38574	38770	29883	32584	34158	36566	36524	38882	54400	70524	50446	49392	40669
Miles per car set out	1922	87351	80470	59799	86102	157592	54608	37327	47804	22256	37016	44806	39681	43073

Summary statement showing total hot boxes by months and comparative mileage figures

East and West Railroad
Statement of hot boxes in freight cars
Year 1923

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Set out of train en route ...	130	109	176	167	223	257	276	259	172	133	123	87	2111
Other hot boxes	216	166	390	367	515	658	522	519	370	316	215	162	4416
Total hot boxes 1923	346	275	566	534	738	915	797	778	542	449	338	249	6527
Total hot boxes 1922	140	125	179	215	167	686	462	567	855	579	402	316	4693
Transportation service miles per hot box													
Total 1923	13358	14499	9173	7773	10243	10264	12433	12458	16331	19500	17007	16263	12512
Total 1922	16871	20592	17198	16820	16623	10683	17853	14534	8641	16137	14139	13611	13302
Loaded car miles per hot box													
Total 1923	10030	9503	6763	7773	8383	8243	9487	9550	12293	14643	13186	10372	9725
Total 1922	10242	12408	11798	10301	10252	6324	9009	8861	7288	10862	14047	9413	9167

Example of report of hot boxes originating at different stations

mileage per hot box. The figures of one division will vary from another. As with most other railroad statistics, they should be always used with caution as relative figures, showing tendencies.

What action can be taken to stop the hot box epidemic? It will be noted that the measures suggested are mostly indirect and preventive. It is necessary to see that the materials supplied are of such quality that under favorable conditions there will be a good bearing upon a journal which is perfectly smooth, against which presses a packing of proper texture to feed an oil of sufficient quality to maintain a film of .003 in. between the journal and the bearing.

But as in every other situation, and more so than in some, the real controlling factor is the human one. Starting with the daily report, let it be the routine practice for the master car builder or his travelling car inspector to make a personal visit to or talk with, by 'phone, every foreman whose station has increased its usual hot box debit for the previous 24 hours. This seems quite a job, but if it becomes evident to the men on the job that a personal explanation will be called for every time the hot boxes increase, there will come the feeling, "Guess it will be well to see that cars are right when they go out." The written letter or memo will never take the place of the personal visit. It is important that the men higher up keep in mind that it is not a question of a "bawling out." The greater part of the time the cause of the hot box was not the fault of any single individual. The attitude should be taken that what is wanted is information. After this practice has been carried on long enough, there will be a steady flow of information on the subject. A distant foreman will report that brasses shipped to him arrived with linings loosened from the back or scored and full of grit and sand. That involves the crew of the local freight perhaps: but it is not a case of trouble for them. Very likely they look upon brasses as pieces of metal to be handled with as little care as brake shoes. A word of friendly explanation may remove that trouble instantaneously and forever.

Next may come one of the men from the receiving department of the store room. He has learned from similar suggestions that waste is not something to wipe machinery with when the car department is concerned, but a medium of transmitting oil to a journal. He has a sample of new waste which makes him suspicious. What does the M. C. B. think of it? Psychology teaches us that we can many times increase the productivity of human labor by affording a point of interest to the worker. Properly handled, this system will provide that point of interest.

When the preventive work has failed, and when the hot boxes increase, then it is necessary to consider the problem, and it can only be handled on the ground. The man who is bucking that problem is the same as the wreckmaster. He must go to the source of the trouble, which he knows from his daily report. What he will find there may be anything that will make a hot box. He must work right with the oilers, he must ride the trains himself and work with the hot boxes which develop to see just what the trouble is. If the trouble lies with a supply of below-grade bearings which have been gradually applied over a considerable time he may have a long job, or it may be that 24 hours work will end the trouble.

The valuable thing about such a system is that it practically stops anything which can be called a hot box epidemic. After the lapse of sufficient time, nearly every man on the road will be interested in keeping down that hot box record, especially if the monthly tendency report is carried on a blue print or mimeograph sheet so that cumulative figures for the year are shown. A copy should be sent monthly without comment, to each repair point.

Mileage figures as already suggested are very delusive when used as means of comparison, so that actual mileage figures will not be stated. But it seems reasonable to affirm that any road which does not have such a close personal check on the hot box problem, regardless of how good its figures look, may expect an improvement of at least 50 per cent in the number of miles per hot box within two years after commencing such a system, besides the immediate location of the place responsible for an attack of "hotboxitis."

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Responsibility for damaged car involved in a derailment

An inspection certificate was issued on April 7, 1922, by the Maine Central for Bangor & Aroostook car No. 6228, which was accompanied with a letter dated April 12, 1922, which explained that the cost of repairs exceeded the prescribed allowance under A. R. A. Rule 120. The Maine Central requested the car owner's authority for the certificate and advice as to what disposition was to be made of the car. Authority was given to repair the car and a bill amounting to $349.61 was rendered for the repairs. It later developed that the car was damaged on the Maine Central in switching at which time C. P. car No. 344,353 was derailed. The Bangor & Aroostook stated that the Maine Central requested authority to issue an inspection certificate but did not mention that the car had been damaged in connection with the derailment of C. P. car No. 344,353, nor did it show how the damage to the car occurred as required by A. R. A. Rule 43. The car owner concluded its case by stating that it was wrongly reported under A. R. A. Rule 120 and should have been reported under Rule 112. This contention was based on Interpretation No. 4 of Rule 32, which states that a car damaged in connection with a derailment carries the same responsibility for damage as a car derailed. These facts place the responsibility for the damaged car on the handling line. The Maine Central maintained that the care failed in switching due to its weakened condition.

The Arbitration Committee rendered the following decision: "In view of the derailment of C. P. car No. 344,353, the Maine Central is also responsible for the damage to the Bangor & Aroostook car No. 6228 which occurred in the same accident."—*Case No. 1326, Bangor & Aroostook vs. Maine Central.*

Failure to apply a defect card at interchange

On September 8, 1923, A. C. L. car No. 39620 and on September 11, 1923, S. A. L. car No. 30715 arrived at Laurens, S. C., in a train of the Columbia, Newberry & Laurens, each car with a centrifugal dirt collector miss-inspection record. The cars were delivered to the ing, which were noted by the car inspector on the original Charleston & Western Carolina with the dirt collectors missing and no defect cars attached as required by A. R. A. Rule 2, paragraph I. The car inspector at Laurens is

a joint inspector for the C. & W. C. and C. N. & L. The C. N. & L. refused to furnish the inspector with any of its defect cards but required him to request all defect cards from its headquarters at Columbia, S. C., a distance of 75 miles, giving the initial and number of the car and the defects in each case. The defect cards are then issued and sent to the inspector. This accounted for the cars being delivered to the C. & W. C. without the defect cards attached as required by the rules. The inspector wrote the C. N. & L. for defect cards to cover these two cars, which were refused on the ground that the cars had gone over the C. & W. C. to Spartanburg, S. C., before the request for defect cards was made. The Charleston & Western Carolina contended that A.R.A. Rule 2 does not provide for any time limit in which to request defect cards and that if the Columbia, Newberry & Laurens had supplied its inspector with a supply of defect cards, so that he could have attached a card to each car before offering it in interchange, as required by Rule 2, the C. N. & L. could not have raised a question. The C. N. & L. claimed that the joint inspector at Laurens failed to note any equipment missing from these cars on arrival at Laurens and as the cars were moved to Spartanburg, S. C. without Rule 4 being complied with, the C. & W. C. should assume the responsibility for the existing defects on the cars.

The Arbitration Committee in rendering its decision stated that, this controversy is due to the evident disregard of Interchange Rules 2 and 4, first paragraphs, which provide for the defect carding of cars at the time and place of interchange. If the cars had delivering line defects, they should have been properly defect carded at the time of interchange.—*Case No.* 1324, *Columbia, Newberry & Laurens vs. Charleston & Western Carolina.*

Passenger car scheduling system

Increases shop output and reduces working force to a minimum—Competent supervision essential for its successful operation

By Joseph Gullage

General foreman, car department, Boston & Maine, Billerica, Mass.

SCHEDULING and routing in railway shops is not new. The first schedules recorded were used in the Chicago & North Western shops in 1904. These consisted simply of working sheets and assigned dates made out and followed up by the shop supervision. Since that time more than 25 railroads have adopted some form of schedule system for repairing cars; all of which are more or less alike in basic principles.

In 1922 at the convention of the Mechanical Division of the American Railway Association at Atlantic City, the Shop Schedule Committee proposed a plan for scheduling cars through the shops. During the latter part of 1922, the Billerica shops of the Boston & Maine put into effect a passenger car scheduling system based on the one proposed by the Mechanical Division committee but modified somewhat to meet the particular conditions at this point. This shop gives general repairs to all types of wooden passenger equipment and the ordinary run of repairs to steel cars. The track capacity of the shop is 60 cars—30 cars in the coach shop and 24 cars in the paint shop—six cars being under wash or paint removal in the latter shop. The output of the heavy and medium repairs is four cars every working day, while the number of light repairs vary. During January of this year, for instance, eight light repair cars were turned out while in February there were 78. However, the monthly average is from 15 to 20 cars.

Points to consider when installing a scheduling system

When installing a scheduling system, there are several items of importance to consider before putting it into effect. If these items are not given considerable thought there is always the liability of the system failing to function properly owing to the lack of proper organization and control.

The first item to consider is the selection of the proper man as the schedule supervisor and to determine the scope of his duties. The man selected for this position should have had wide experience in shop and office work, should be capable of handling men and should have enough engineering practice to make clear reports and records. Preferably this man should have served his apprenticeship as a car repairman and be more or less familiar with shop production methods. Before putting the scheduling system in force, it is always advisable to send the schedule supervisor to visit various production shops to study the methods used to increase production.

Shop bulletin sheet which is displayed on or near one end of each car under repair

The supervisor's duties should be definitely determined. At this point he is required to digest the inspectors' reports as to the general condition of the cars to be

repaired, on the strength of which the schedule time is set by him for the completion of all the work, subject, of course, to the general foreman's approval. He also has direct charge of the shop inspectors, the receiving yard for crippled cars and the outgoing tracks for repaired cars. foreman makes the final decision in case his decision does not meet with the approval of those concerned. His office provides the reports on shop output and shop conditions. He acts as a sort of a liaison officer between the different foremen on matters pertaining to shop output.

NUMBER OF DAYS IN SHOP	9	10	10	14	15	16	12	15	22	17	34	37	22
EXTRA PAINT & OTHER WORK									BURN	BURN			
SCHEDULE / OPERATION	A	B	C	D	E	F	G	H	J	K	L	M	N
						PAINTERS							
START WASH		2	2	2	2	3	2	2	3	2	2	2	2
FINISH WASH - IN & OUT		2	2	2	2	4	2	2	4	2	2	2	2
TOUCH UP : BEGINNING	6	6	6			10	7						
START BURN								2	3	2		3	3
FINISH BURN								2	4	3		3	3
SAND - AFTER BURN								3	4	4			
PRIME - OUTSIDE				6-7	7-8			7-8	12-13	9-10	27-28	31	14-15
PUTTY,SAND & SURFACE NO.1				8	9			9	14	11	29	32	16
SURFACE NO.2					10			10	15	12			17
SAND & COLOR NO.1	7	7	7	9	11	11	8	11	16	13	30	33	18
ENAMEL	8	8	8	10-11	12-13		9-10	12-13		14-15	31-32	34-35	19-20
COLOR NO.2													
VARNISH NO.1		9		12	14	12	11	14	17-18	16	33	36	21
VARNISH NO.2						13			19		15		
VARNISH NO.3													
ENAMEL NO.2													
LETTER		9	9	11	13	13 PM	11 AM	13 PM	18 PM	15 PM	32	35 AM	21
PAINT UPPER DECK	7	7	7	10	9	11		11	16	13	29	33	16
PAINT LOWER DECKS	7	7	7	10	9	11		11	16	13	29	33	16
START INTERIOR		6	6	7	9	11	8	9	16	11	29	30	16
FINISH INTERIOR		9	9	11	12	14	9	13	20	15	32	34	20
STEPS, PLATFORMS		7	7	10	8		10	13	17	15	30	33	20
BOTTOMS, TRUCKS		7	7	10	8			13	17	15	32	30	21
FINISH DECKS, STEPS, ETC,		9	9	10	12	14		15	18	15	32	36	21
STENCIL	9			13									
TOUCH UP - FINISH						14			20	16			
						CARPENTERS							
TRIM STRIP													
DISMANTLE FOR STEEL U'FRAME													
START BODY	1	3	3	3	3	5	3	4	5	5	1	4	4
START PLATFORM WORK		3	3	3	3	5	3	4	5	5	1	4	4
FINISH BODY	5	5	5	5	6	9	6	7	12	8	26	28	14
FINISH PLATFORM WORK		5	5	5	6	9	6	7	11	8	26	28	14
				CABINET MAKERS (BENCH FINISH - 1)									
STRIP START		1	1	1	1	1	1	1	1	1		1	1
STRIP FINISH		1	1	1	1	2	1	1	2	1		1	1
WORK START		3	3	3	3	5	3	4	5	5	1	4	4
WORK FINISH		5	5	5	6	9	6	6	11	7	20	24	12
						TINSMITHS							
ROOF START		3	2	3	3	5	3	4	5	5		4	4
ROOF FINISH		5	4	4	6	8	6	7	11	7		26	13
TRIM FINISH (IN TIME TO SHIFT)						9			11		25		
						STEAMFITTERS							
PIPE FINISH, COVER & TEST		5	5	5	6	8	6	7	10	8	24	24	14 AM
						TRUCKS							
DISCONNECTED, - OUT	1	3	3	3	3	5	3	4	5	5			
OVERHAULED - START	1	3	3	3	3	5	3	4	5	5			
OVERHAULED,FINISH,UNDER & CONN.	5 AM	5 AM	5 AM	5 AM	6 AM	9 AM	6 AM	7	11 AM	8 AM	25	28 AM	14 AM
						AIR BRAKES							
FINISH, TEST	9	10	10	14	15	16	12	15	22	17	34	36	22
						ELECTRICIANS							
ALL WORK FINISHED & TESTED		5			6	9	5	7	22	8		24	
						BLACKSMITHS							
ALL WORK - FINISHED	4	4	4	4	5	7	5	6	9	7	20	22	12
						UPHOLSTERERS & BRASS WORK							
STOCK RECEIVED		2	2	2	3	4	3	2	4	2		2	2
TRIM STOCK FINISHED									18			24	20
						MACHINISTS							
ALL WORK, FINISHED	4	4	4	4	5	8	5	6	9	7	21	22	12
						CAR TRIMMERS							
TRIM FINISH	9	10	10	14	15	15-16	12	15	21-22	17	34	37	22

This chart is a summary of the passenger car schedules and is put in this form for the convenience of the schedule supervisor

A yard shifter is assigned to the shops for transfer work, the engine crew of which takes orders from the schedule supervisor. His work also includes decisions as to the standard of workmanship which may be in question between his inspectors and the shop foreman. The general

The location of the office of the schedule supervisor is the next item to be given consideration. This office should be located conveniently with respect to the shops, preferably in the office of the general foreman, which is the case at the Billerica shops. It is important to have this office

so located that the supervision can frequently confer with the schedule supervisor and have ready access to and examine the records on the schedule board.

The master schedule

As each car comes into the yard an inspection of the car and painting is made to determine the class of repairs. The arranging of a schedule depends largely on the longest job on the car, which is usually the paint. It is then good policy to have the painters start their work as soon as possible and arrange to have the other work on the car finished at the same time that the painters start.

The first requirement of the schedule supervisor at Billerica was to plan the master schedule. The schedule, which is shown in the large illustration, is a board upon which is laid down the work to be done on all possible units of equipment used by the B. & M. which come to the Billerica shops for repairs or rehabilitation, from the dining car to the box car carrying a coat of pullman color and the words "Fitted for passenger service," stenciled on its side.

Referring again to the master schedule in the illustration, on the left, will be seen the names of the different paint operations and crafts. The painting operations appear first, which as previously mentioned, determine the length of time the car will be in the shop. For example, it may require as many as 14 paint shop days for a dining car which is made necessary because one coat of paint or varnish must be dry before another can be applied. It is essential to show all the paint operations complete on the master schedule.

The other crafts shown on the board are merely mentioned by name, as a board showing all the various jobs of all the crafts would be one of impossible dimensions and almost out of the question to read.

On the top margin of the schedule, at the head of each column, is a row of letters A, B, C, and so on up to N. Immediately above these letters are figures running from 9 to 37. The letters indicates the type of car and the class of repairs and the amount of paint work necessary for each car, while the numbers indicate the total days required to perform this work and the total days the car is in the shop.

How the master schedule is used

To make clear to the reader the application of this schedule to a particular class of work, we will follow a car through the shop according to schedule *M* on the master schedule. This schedule calls for 37 shop days in which time a vestibule passenger coach will receive a steel underframe, the vestibule will be reconstructed and the outside body paint removed and reapplied. On Day 1, the strippers strip the car and distribute the various parts to the proper departments for repair. At this point it is well to mention that the departments are informed as to when they should have the parts for which they are responsible repaired and back to the shop in time to be reapplied in the car. This time is flexible insomuch that each department can finish each part of the work beforehand and store it away until required. Coming back to the master schedule, on Day 2, the car is washed and finished both inside and out. On Day 3, the car is moved to the track where it will stay until turned out. On this day the painters burn the paint off of the car complete. On Day 4, the carpenters start to work on the body and the vestibule of the car. The tinsmith and the truck gang also start their work on this day. It will now be seen that all crafts are working on this car in order to complete it by the end of the 37 shop days. By the twenty-eighth day, all of the crafts have finished their work. Machinists and blacksmiths finish on the twenty-second day. The upholsterers and brass workers, the electricians, steam fitters and cabinet workers finish their work on the twenty-fourth day. The tinsmiths on the twenty-sixth day and the carpenters on the twenty-eighth day. The car is now free for the painters to work on.

Should any hidden defects appear during this time that will necessitate a longer time than allowed by the schedule to complete the work, this situation is generally overcome by increasing the number of men employed on the job, taking them from a car just in the shop or from one on which there is but little to do. This procedure usually prevents the car from going out late.

The car moving through the shop on schedule *M* is now complete in so far as all the crafts are concerned except the painters. The car is now in the paint department where on the thirtieth day the painters start to work on the interior and finish on the thirty-fourth day. The trucks and the bottom of the car are also painted on the thirtieth day. On the thirty-first day the painters start the outside of the car and finish it by the thirty-sixth day. On this day all paint work is finished as well as all the repairs to the air brake equipment. On the thirty-seventh or last day in the shop, the car is in the hands of the trimmers who usually complete their work in time for the shifters to pull the car out of the shop, 99 per cent complete. There is always a final inspection and touch-up time is required, which takes place after the car leaves the shop. When complete, the inspector carefully goes over the car and declares the car ready for service on the date assigned. This is a typical case and the movement of all the other cars through the shop is similar.

REPAIR CAR DELAY SLIP

BOSTON AND MAINE R.R -- CAR DEPARTMENT

CAR NO _____ SCHEDULE _____ DAYS _____

DATE IN _____ DATE OUT _____ SHOP _____ TRACK _____

CAUSE OF DELAY

_____

_____

_____

DATE _____ _____ FOREMAN

Pink delay slip which must be filled out by the foreman who is responsible for retarding the progress of a scheduled car

The use of the individual schedule board

In order to make this schedule system effective, it is essential to have a number of cars on the waiting list for repairs. With 20 or 30 cars waiting to come in the shop, it is much easier to maintain a steady run of output than is possible if only 6 to 10 or less cars are on hand. These crippled cars can be arranged to pass through the shop in such a manner that neither the paint nor coach shop will be overloaded to the detriment of the other. After the cars have been arranged on the waiting list, according to the class of repairs required for them, the inspector goes over each car in as thorough a manner as is consistent with his other duties, making notes of the condition of the car so that when it arrives in the coach shop the inspector assigned to that shop can, with the data gathered by his colleagues, immediately hang a card on the car which carries a summary of the defects for the benefit of the foreman in whose section the car has been placed for repairs. This card is also of first importance to the schedule supervisor who at a glance can grasp the extent of the necessary work to be done, and with that coupled with his own observation and the chart of the cars in the

coach and paint shop, he can immediately assign a date for the completion of the coach shop repairs as well as of the paint and the trimming.

When the schedule has been determined and the dates have been placed on the planning board, a schedule board is then written up and placed on the car where it remains until the car is complete. The information contained on this board is copied on the form shown in one of the illustrations by the schedule supervisor who sends duplicate copies to each of the foremen who is responsible for any of the work done on the car.

The schedule board is about 18 in. by 24 in. At the top is placed the number of the car and immediately below it, the schedule letter and shop days for completion. Below this appears the number of days in the shop and following this is a list of the various operations to be performed on the car with the start and finish time after each item.

BOSTON AND MAINE RAILROAD

MECHANICAL DEPARTMENT

No BILLERICA SHOP · CAR DEPARTMENT

SCHEDULE -- B DAYS -- 11

CAR No 479 DAY IN 8-21-24 DAY OUT 9-3-24

DAY IN SHOP

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

CRAFT	START	FINISH	NOTE
STRIP	1	1	
WASH	2	2	
CAR BODY	3	6	Due 8-27-24
CAR PLAT.	3	6	
CAB'T MAKER	3	5	
TINSMITH	3	6	AM
TRUCKS	3	6	AM Down & Level
STEAMFITTER	3	6	AM
BLACKSMITH	3	4	
MACHINIST	3	4	
AIR BRAKE		11	Test - Final
GAS, OIL, ELEC.		11	Lights - Complete
UPHOLSTERER	2	8	Due 8-29-24
BRASS WORK	2	8	
PAINT OUT	7	10	
PAINT IN	7	10	
TRIMMER		11 12	Trim Ship

This form contains the same information found on the schedule board which hangs on the car under repair—A duplicate is sent to all the foremen interested

The start and finish columns are important, and as each day passes the checker marks off the vital days as they terminate until he comes to the day on which the work of the carpenters should be complete. If the car is delayed a day or more, every day it is late is checked off the schedule and a report is filed in the office of the general foreman for his information. If the information is sufficient and satisfactory, the general foreman accepts the report, but if he feels that it is not acceptable, he asks for a pink slip, or repair card delay slip, from the foreman in charge, which must clearly state the cause or causes of delay. If these causes are such as will warrant the excuse of the foreman then the delay is passed on to the originator of the cause. This delay slip, which is shown in one of the illustrations, is very effective as the foremen bend every effort to avoid a pink slip. As a result of this co-operation on the part of a foreman, a delay chargeable to negligence has never been filed at the North Billerica shops.

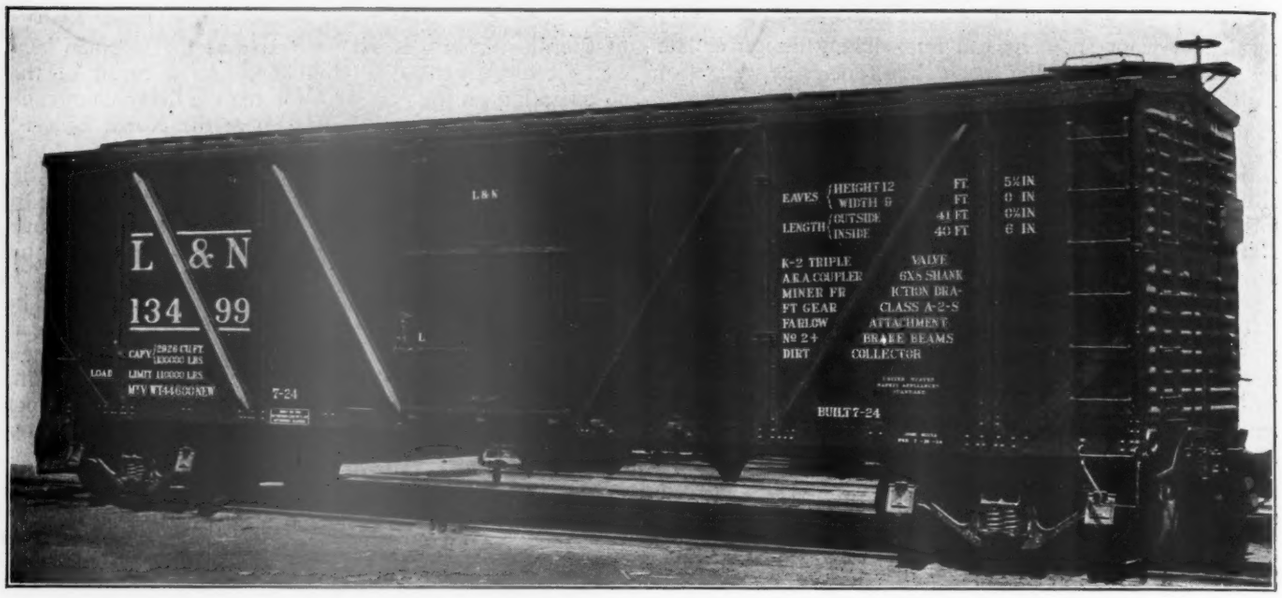
The different crafts working on the car within the carpenter days, do so according to the days which are assigned for their particular work. As each craft completes his work, the foreman O. K.'s the board against his craft's name, so that when the coach shop foreman is ready to send the car over to the paint department, he looks over the schedule board on the car to determine if the tinsmith, truck department, etc., have completed their work as required. With the board completely checked off, the paint shop will have no delay on account of work not being finished in the coach shop. Neither will the painter have any hammering on the body of the car which causes dust to fly through the air and settle on the fresh varnish, which naturally does not add to the appearance of the finished car.

The master schedule is supplemented by a large planning board which carries 31 blocks, to cover days in the longest month. Each block is divided vertically into four columns, one each for the car number, the date in, the schedule designation and the date out. Horizontally, each block is divided into two parts, one for the coach shops and one for the paint shop, and each of these parts contains six horizontal lines to accommodate a record of a maximum of six cars. As each car is given a date out of the coach shop, the car number, its date in, schedule designation and final completion data are entered in red in the coach shop portion of the block representing the schedule day out of the coach shop. The same information, with the exception of the completion date is entered in blue in the paint shop portion of the block representing the final completion date. The purpose of placing the car number in these spaces is so that no more than four or five cars, which carry the same completion date will be scheduled out of either the work or paint shop on the same day, as any more than that number would mean a delay. The daily capacity of the paint shop is around four to five cars. Therefore, in order to avoid confusion, it was found necessary to employ some scheme of separation. The planning board tends to smooth out the output in a steady, even flow of a predetermined number of cars for each day.

Benefits derived from a scheduling system

Schedule boards indicate infallibly where delays periodically or persistently occur and such departments may be built up or strengthened. Under the day work plan, which is used at this shop, the system acts as a stimulant and to some extent, takes the place of interest in the work removed through the abolition of piece-work methods. Friction between departments is almost entirely eliminated. It is not possible to unload on one department causes for delay which belong to another.

This system to some extent establishes tasks or jobs. Every conscientious foreman or workman likes to have certain work to perform in a stated time and to feel confident that this is exactly what is wanted. Each schedule date delivered to the foreman or workman becomes a written order to that man to deliver the work on that date. Unnecessary driving is brought to a minimum. Dates are assigned and if the work is properly done on these dates, no criticism or censure is necessary. The constant reappearance of the daily delay report stimulates foremen and workmen to a better purpose than criticism. Scheduling has enabled us to reduce our man power to the proper ratio to the output.

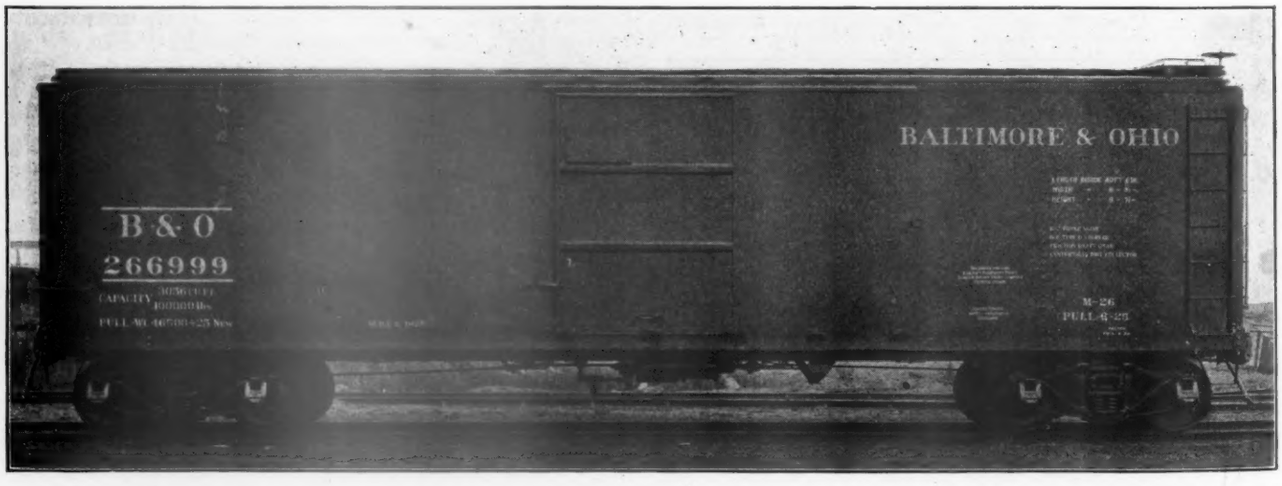


Louisville & Nashville standard 50-ton single-sheathed box car—Builder, Mt. Vernon Car Manufacturing Company

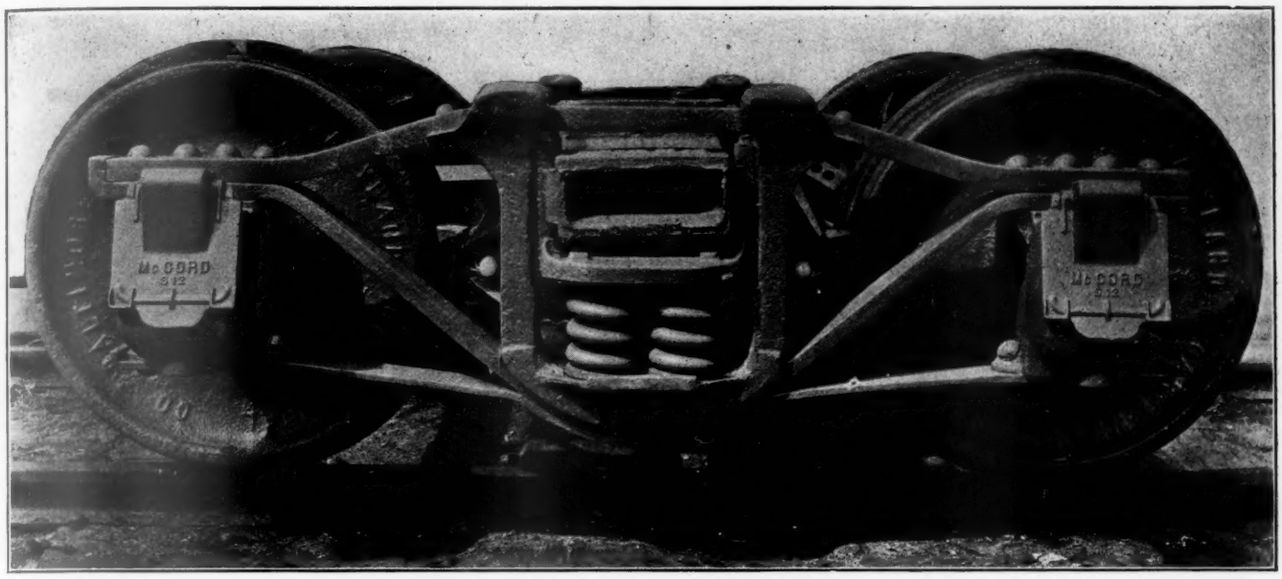
Exhibit of proposed standard box cars at Chicago

Built from designs proposed by Committee on Car Construction—B. & O. shows two all-steel cars with trucks of special design

ONE of the features of the recent meeting of the Mechanical Division of the American Railway Association held at Chicago was the exhibit of the present and proposed standard box cars which was shown on tracks No. 4 and No. 5, slip A, South Water street yard of the Illinois Central. This exhibit constituted a most instructive and valuable supplement to the report of the Committee on Car Construction, an abstract of which was published in the July *Railway Mechanical Engineer*. These cars, which included both the proposed double—and the present standard single-sheathed types, were sent to Chicago by a number of representative railroads. They were interesting, not only because they were built in accordance with the standard designs as worked out by the committee, but also on account of the fact that they embodied many alternatives which can be applied without departure from any essentials of the standard design. In addition, the B. & O.



Baltimore & Ohio 50-ton double-sheathed box car—Builder, Pullman Car & Manufacturing Corporation



The Tatum XLT truck used on one of the Baltimore & Ohio box cars

also exhibited two all steel cars equipped with trucks of special design. The following is a brief description of these cars.

The A. T. & S. F. 40-ton double-sheathed box car

An illustration of the A. T. & S. F. 40-ton double-sheathed box car of the proposed standard design 4C-XM2 was shown on page 426 of the June *Railway Mechanical Engineer*. The equipment thereon includes:

Trucks: A. R. A. side frames on both trucks. The truck at the "A" end of the car has an A. R. A. bolster design with separate center plate and standard friction side bearings The truck at the "B" end of the car has a separate center plate and bolster design modified to accommodate the Barber lateral motion device and Barber roller side bearings. A. R. A. standard springs and spring plank are used on both trucks.

Brake beams: The truck at the "A" end is equipped with a Creco No. 2 beam and standard A. R. A. suspension hanger. The truck at the "B" end has a Creco No. 2 plus brake beam, Santa Fe standard malleable hangers and Santa Fe brake beam safety suspension.

Connections and truck levers: A. R. A. standard is used with both.

Journal box lids: The truck at the "A" end has Asco self-fitting torsion spring lids; the "B" end of the car has Symington B-2-A malleable lids.

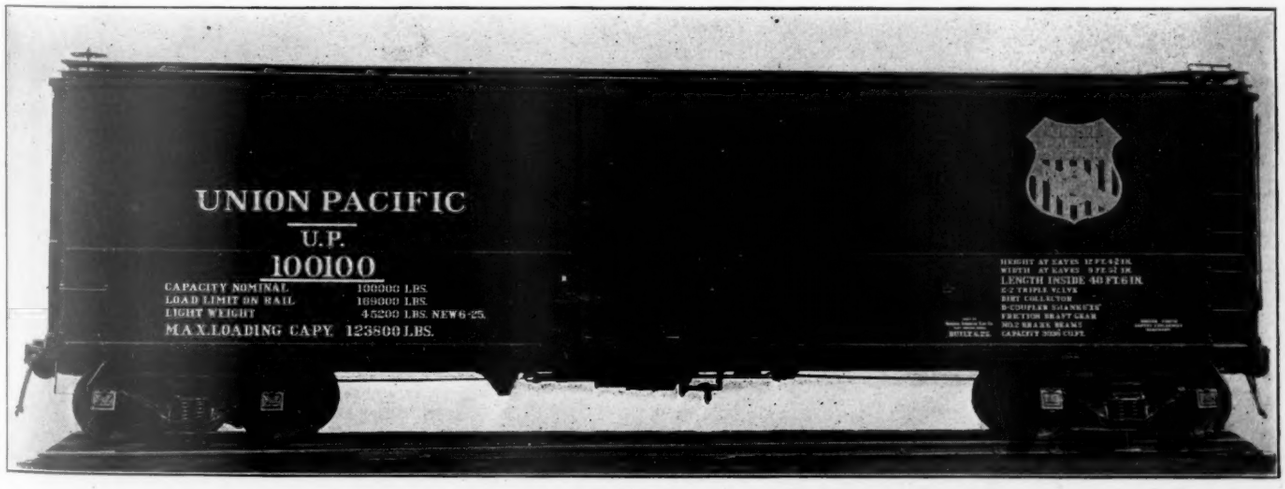
Ends: The "A" end of the car has a built-up standard end with posts; the "B" end has a Murphy corrugated end.

Side doors: Both doors are bottom hung. One door has A. R. A. standard sections of framing. The door posts on one side of the car are pressed as shown on the proposed standard design (see page 433, July *Railway Mechanical Engineer*); the other side of the car has the front door posts pressed, but with the front stop omitted. The front stop is a Camel section, riveted to the post. The rear door post is pressed with the outside flange omitted, and Camel weather strips are riveted to it. The rear frame of the door on this side of the car has a Camel standard pressed angle, while the front framing includes a Z-bar providing the necessary lap in the front stop. The top and bottom framing is made of Z-bar sections, as shown on the standard details.

Roof: Murphy radial all-steel flexible roof.

Yokes: Santa Fe standard cast steel yokes made by the American Steel Foundries.

Draft gear: National friction draft gear, type M/17,



Proposed standard 50-ton box car with wood sheathing and lining—Builder, General American Car Company

at the "A" end of the car, and Miner friction gear, type A-2-X, at the "B" end of the car.

Uncoupling device: Santa Fe standard, Imperial type A at both ends of the car.

Body side bearings: At the "A" end of the car, A. R. A. standard design. Those at the "B" end of the car are modified to accommodate Barber roller side bearings.

Air brake: Westinghouse.

Marking: Santa Fe standard, conforming to A. R. A. specifications.

The Union Pacific 50-ton double-sheathed box car

This car is 46 ft. 6 in. long inside and has a capacity of 3,038 cu. ft. The light weight is 45,200 lb. which leaves a maximum loading capacity of 123,800 lb.

The equipment on this car, which is of the 4D-XM2 class (see page 428, July *Railway Mechanical Engineer*), includes:

Trucks: The "A" end has Huntoon brake beams, Schaefer brake hangers, levers and connections; Wood's roller side bearing, and Allegheny Steel Company's journal box lids. The "B" end has Creco beams and Railway Steel Spring Company's journal box lids.

Ends: The "A" end of the car has a corrugated end; the "B" end of the car is of the standard built-up type.

Uncoupling device: Carmer.

Side doors: One side has an A. R. A. standard top-hung door and fixtures. The other side has a modified Camel top-hung door and fixtures.

Roof: Murphy solid steel riveted type.

Yokes: Buckeye steel yokes at both ends.

Angle cock holders: Western Railway Equipment Company at the "A" end, and A. R. A. at the "B" end.

Draft gear: Murray on one end and Cardwell on the other end.

Air brake: New York.

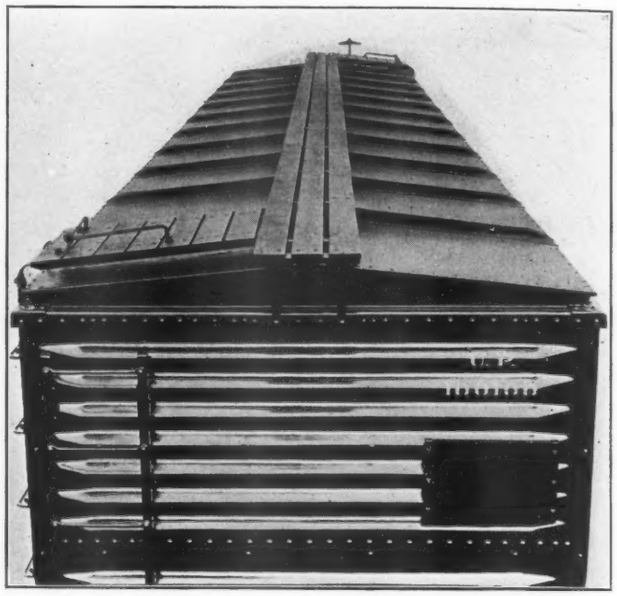
Nuts: Grip and boss nuts.

Marking: Union Pacific standard.

Notes on the 40 to 50-ton double-sheathed cars

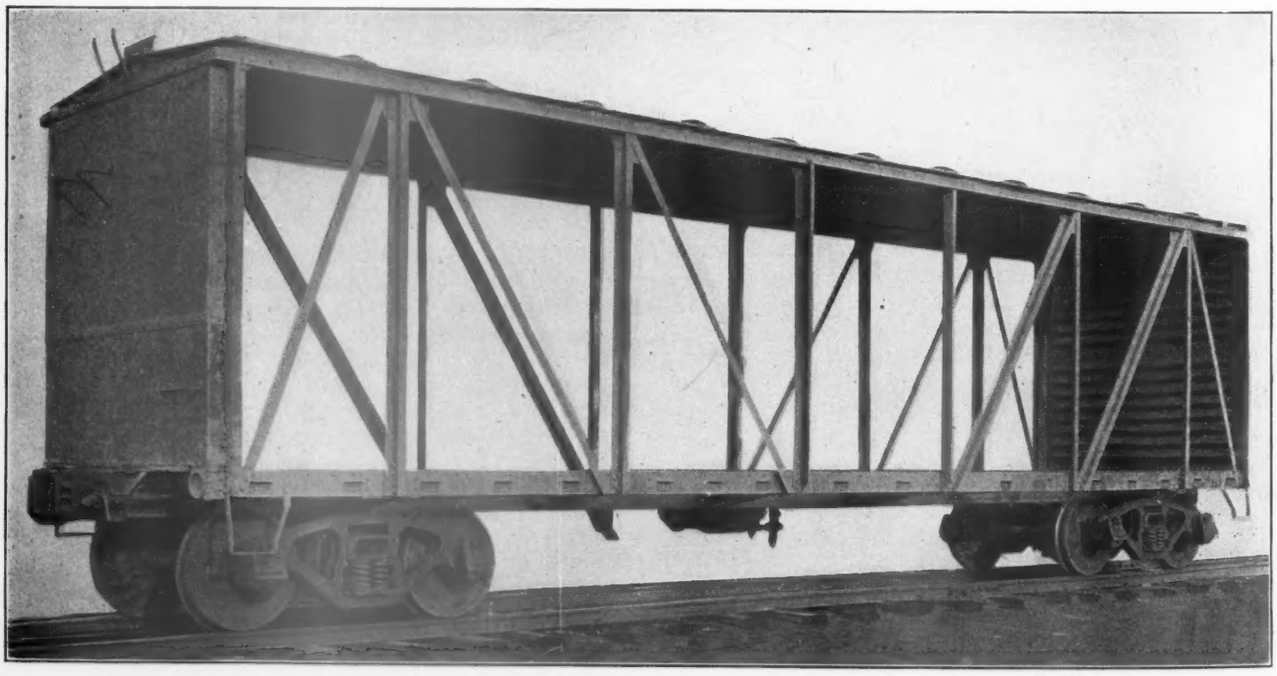
In general construction the 40-ton and the 50-ton double-sheathed box cars are the same, although various parts are naturally of lighter construction for the 40-ton car. Some of the differences are enumerated herewith.

The underframes are of the same standard section as that previously adopted for single-sheathed cars, the differences in the frames being so slight that if adopted for the double-sheathed car the same design could be incorporated in the single-sheathed car. The crossbearers have been moved to coincide with the location of the door



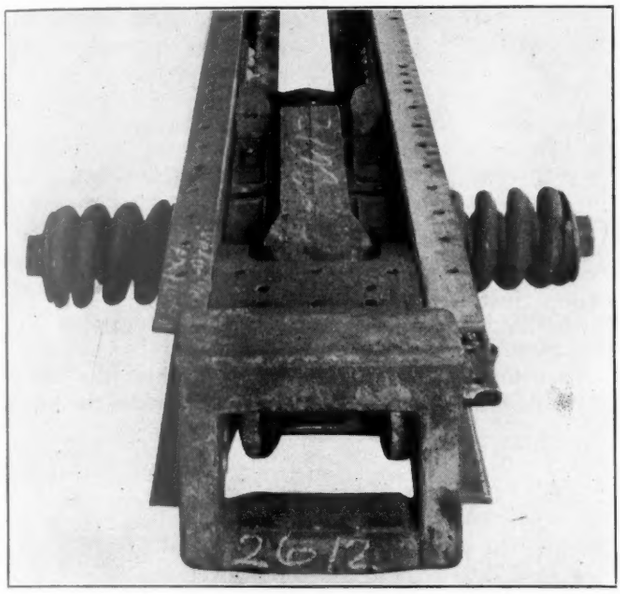
Murphy solid steel roof and the corrugated steel end of the Union Pacific car

posts, a change that could readily be adapted for single-sheathed cars. The body bolster top cover plates are ½-in. thick for 50-ton cars and ⅜-in. thick on 40-ton cars. The same difference occurs in the crossbearer top cover plates. These dimensions can apply also to single-sheathed cars. The side sills are punched the same for



Body framing of the Union Pacific car, mounted on temporary trucks—Built-up steel end at the left

both top and bottom-hung doors. The Z-bar side plates are ¼-in. thick for 40-ton cars and 5/16-in. thick for 50-ton cars. The transom posts are ⅜-in. thick for 40-ton cars and ½-in. thick for 50-ton cars. The punching for posts, braces, sills and plates are identical for cars of either capacity. The end sill angle has been shifted 1 7/16-in. but the same punchings of the underframe have been retained, the punching of the sill being changed to



Combined draft gear lug and end stop casting

suit. The end plates are the same shape but they have been offset in order to accommodate vertical posts or built-up ends. The holes in the end sill angles have been spaced so as to take a standard uncoupling device.

A particularly interesting feature of the design is the combination dead block and front draft lug. This combination is shown in one of the illustrations.

Louisville & Nashville car

The sample car exhibited by the Louisville & Nashville is of the standard single-sheathed design, in the construction of which a number of alternates have been incorporated. It is of 50-ton nominal capacity and weighs 44,600 lb. light. It has corrugated steel ends and XLA outside flexible metal roof. The draft gear is Miner friction, class A-2-S with Farlow attachments; the coupler release attachment is the Carmer. The trucks have cast steel side frames with journal boxes cast integral. The truck bolsters are fitted with roller side bearings.

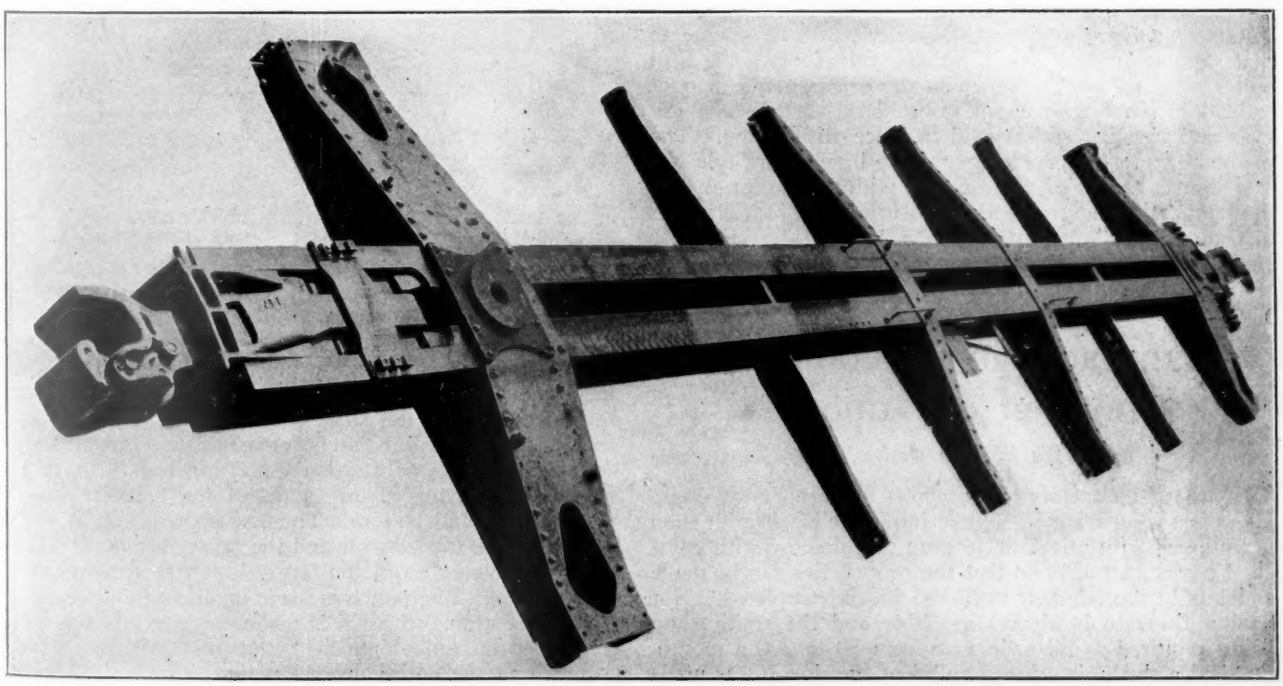
The B. & O. double-sheathed cars

Two 50-ton double-sheathed cars with two new types of trucks were exhibited by the Baltimore & Ohio. These are 40 ft. 6 in. long, 8 ft. 9⅛-in. wide and 8 ft. 7⅜ in. high—all inside measurements. The capacity is 3,056 cu. ft. The light weight is 46,900 lb. which leaves a maximum loading capacity of 122,100 lb.

One of these cars was equipped with the Tatum patented arch bar flexible truck which is built without bolts, nuts, washers or keys, except for the brake pins and the lower connecting rod, and the brake pin used in the live lever rod connected to the bottom brake rod. The column post is locked to the top arch bar by wedges and rivets. The bottom arch bar and the tie bar are free from any sharp bends. The side frames are flexibly connected by a 6-in. pivoted channel bar. This truck design includes the Tatum-Zell waste and oil retainer, a brake beam suspension without brake hangers and fulcrum bar safety straps.

The other car was equipped with the Washburn patented arch bar truck side frame, which was described in the *Railway Mechanical Engineer,* May, 1924. There is quite a difference between the weight of the Washburn truck and the standard M. C. B. truck. The M. C. B. arch bar truck with 1¼-in. by 6-in. arch bars weighs 8,640 lb. with the lateral motion device. The XLT truck weighs, without the lateral motion device, 8,145 lb.

In discussing the 1925 report of the Committee on Car Construction one of the committee members, J. J. Tatum,

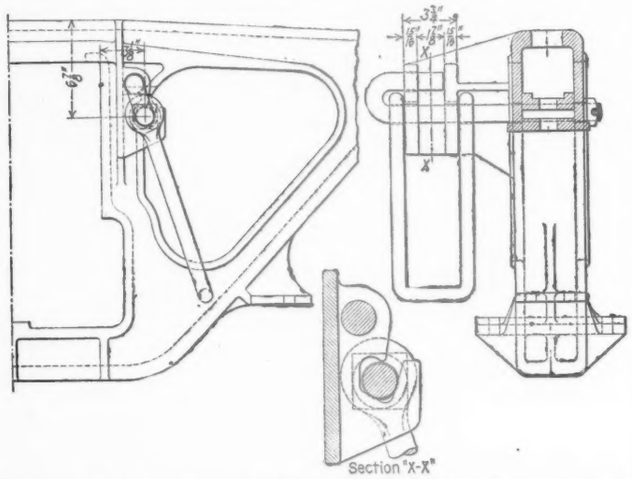


Inverted underframe of the proposed standard double-sheathed box cars

general superintendent car department, Baltimore & Ohio, stated that the committee was not prepared to give the comparative strength of the two trucks under the two different cars, but the M. C. B. arch truck under a static load of 125,000 lb. deflected 1.50 in. and had a permanent set of 1.23 in. The XLT truck under the same load deflected 0.19 in. with a permanent set of 0.10 in.

Proposed brake hanger bracket

The Baltimore & Ohio is also investigating the possibilities of a brake hanger bracket for cast steel truck side frames. Five proposed styles have been developed, of which Style No. 2 is shown in the drawing. The bracket design is the same for all five proposed styles. The method of applying the hanger, however, is different. The hanger shown in the drawing is the proposed A. R. A.



Proposed Style No. 2 of brake hanger bracket for cast steel side frames

standard brake beam hanger, Classes 2C, 2D and 2E. Style No. 1 is made to the same dimensions as the proposed standard hanger, but is forged in a solid loop, the top portion of which is flattened so that the hanger can be inserted into the hook of the bracket. The proposed standard hanger is also used in Style No. 3, similar to that shown in Style No. 2, but instead of using the bent bolt and castle nut as shown in the drawing, the hanger is held in place with a pin inserted through the hanger eyes and bracket, and is held in place with a key. The method of applying the hanger to the bracket in Style No. 4 is similar to that of Style No. 2, with the exception that the hanger is made to be inserted inside the bracket jaws instead of outside as shown in the drawing. Style No. 5 employs the same type of hanger as Style No. 4 but is secured by a pin and key as in Style No. 3.

Manufacturing eyebolts for hopper car doors

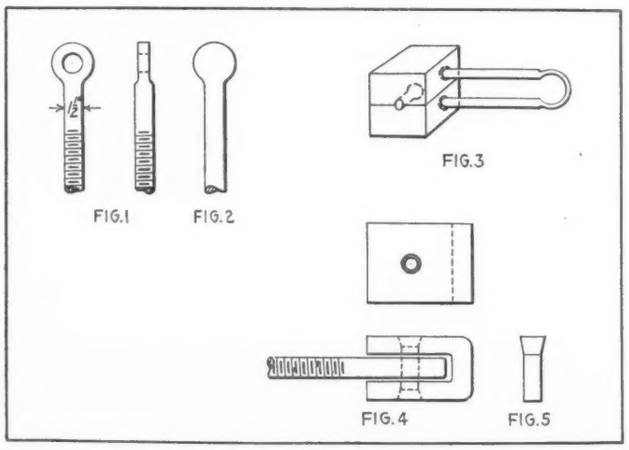
By F. E. Deissler

THE manufacturing of eyebolts for hopper car doors is a comparatively simple job if the blacksmith shop is equipped with a bolt or forging machine, or with sufficient power hammers so that the proper dies can be made and left in the hammer until the job is completed. Not having these tools always available and the smith shop being required to fill orders of from 50 to 200 a month, the device shown in Figs. 3 and 4 of the sketch was made so that the steam hammer could be used for other work when necessary.

The kind of eyebolt made is shown in Fig. 1. The material used is 2½-in. round stock which is cut off at the shears to the required length, heated, balled at one end and flattened. The other end is then drawn out to 1½ in. diameter. Sufficient heat remains to punch the hole while the piece is still hot and the job is completed except for the threading.

The tools used for this work are the spring swedge, shown in Fig. 3 and the die and punch shown in Figs. 4 and 5. These tools are made by forging a master ball as shown in Fig. 2. The two blocks of steel for the spring swedge are then forged to the required size and reheated. The master ball is placed between the two blocks which are driven together under a steam hammer. After the blocks are cooled, holes are drilled the same size as the bar used for the handle as shown in Fig. 3, and shrunk. The job is completed by inserting the ends of the spring handle in the holes and electric welding around the handle to prevent it from coming out or turning. If the electric welder is not available, the handle can be secured just as satisfactorily by drilling a ¼-in. hole down through the block and handle and driving in a steel plug.

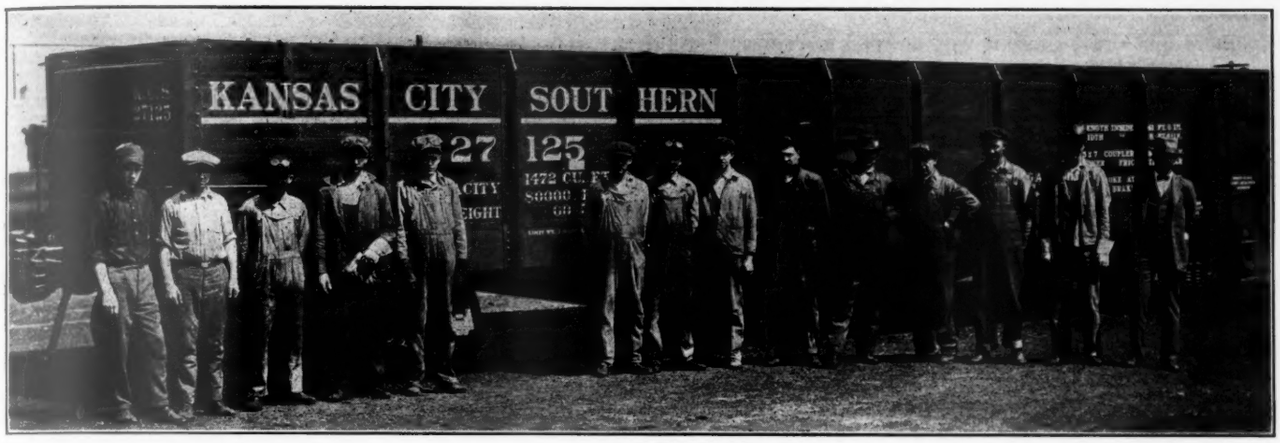
After the handle has been applied, reheat the blocks, place the master ball in the swedge and close the blocks



Quantity production of eyebolts can be obtained with this device on a power hammer—No permanent dies or special equipment are required

down until they come together, using a little water on the master ball to help clean out the scale and make a smoother tool. The swedge for the bolt shank is made in the same manner as described for the ball, only a piece of round iron is used instead. Care should be taken to make the grooves wide enough and at the right depth so that the work can be turned freely and the swedges will not pinch at the edges.

The die and punch are made as shown in Figs. 4 and 5. The die is made from a piece of 1½-in. tire or tool steel bent to the shape shown, allowing about ¼ in. clearance between the sides of the opening and the material to be punched. The holes should be 1/16 in. larger than the diameter of the punch and tapered ⅛ in. larger at the top, leaving about ½ in. of the hole straight at both the top and bottom. Thus, when one side is worn, the die can be turned over and the other side used. When the hole becomes worn too large, it can be drilled out to a larger size. The punch is made tapering to about ½ in. from the bottom, where it is made straight. If the holes are drilled instead of punched, the work will cost nearly as much as the entire operation just described. On the other hand, if the eyebolts are finished cold, the work will require extra handling, which adds to the cost.

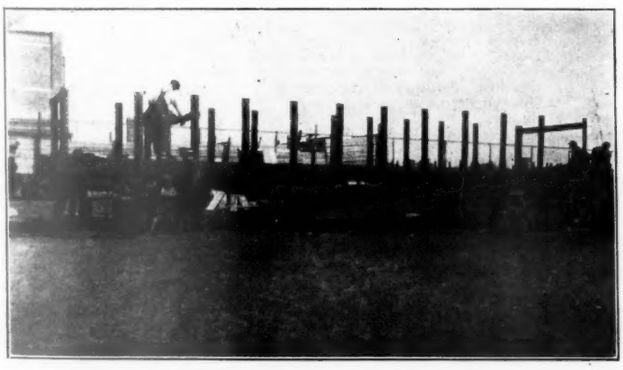


The completed car and apprentices who repaired it—C. Y. Thomas, apprentice supervisor, at extreme right

Apprentices repair gondola unaided

Kansas City Southern car shop apprentices give practical demonstration of their knowledge

WITH no intention of breaking records, but simply to show the results of apprentice training and to increase the incentive and interest of the boys in their work, it was recently decided to have a group of apprentices at the Pittsburgh, Kans., shops of the Kansas City Southern completely rebuild a freight car. As a result, 13 of these boys were selected, and they performed



Lining up side stakes after riveting—Body bolsters riveted in —Straightening end sill, B end

without assistance all the operations involved in giving Class 1 repairs to a composite gondola in four days, or slightly over five days if the time required for painting is counted. A 27,000 series, K. C. S. coal car was chosen for the test, this type of car having a steel underframe and being of 40 tons capacity, 42 ft. 7½ in. long and 8 ft. 10¾ in. wide, equipped with Andrews trucks. These cars were built in 1913 and are now being given heavy repairs for the first time.

The car selected, No. 27,125, was set at the Pittsburgh steel car shop May 11, being left outside the shop to facilitate photographing. It was stripped of sides, end boards and nailers, the stripping being done as usual by laborers on the stripping track. Laborers also sand blasted the underframe.

The apprentices working the car were placed under the direct supervision of an apprentice who acted as lead man. No assistance of any kind was given the apprentices by the car repairers, car foremen or lead man. All necessary instructions, few in number, were given by the supervisor of apprentices, C. Y. Thomas, and the superintendent of machinery, M. A. Hall, who kept in close contact with the progress of the work because of his keen personal interest in the apprentices and all that they do.

The apprentices selected and assigned to the work on the car were as follows:

Lead man	George Dixon
Gun men	Ben Throne and Oliver Foltz
Buckers	Glen Watson and Gerald Burris
Pickups	John Baker and Hughie Carey
Heater	Floyd Clanton
Mill work	Wilfred Atkinson and Walter Hanes
Air work	Wilfred Atkinson and Milford Stuckey
Painters	Kenneth Lindsay and Elmer Wolfe

The average length of apprenticeship of these boys was approximately 14 months. While the purpose of the test was to show what the apprentices could actually do and it was not intended to be a time or small cost performance, the repairs on the car were made as rapidly as consistent with good workmanship. The total time required, as well as the time when each operation was completed, is shown in the Log of Repairs. The total cost of the job for labor and material was $880.74.

The trucks were in poor condition and it was found necessary to dismantle and completely rebuild them, using the following new parts:

2 new cast steel truck bolsters	4 new Andrews side frames
2 new pairs of wheels	4 new spring caps
1 new box lid	4 new spring rests
16 new box bolts	4 new journal brasses

After assembling the truck next the shop building, it was inverted to facilitate riveting the spring planks and bottom tie bars, while the other truck was jacked up alternately on its sides to be riveted. As soon as the riveting was completed, the boxes were packed and the center plates greased, making the trucks ready for application.

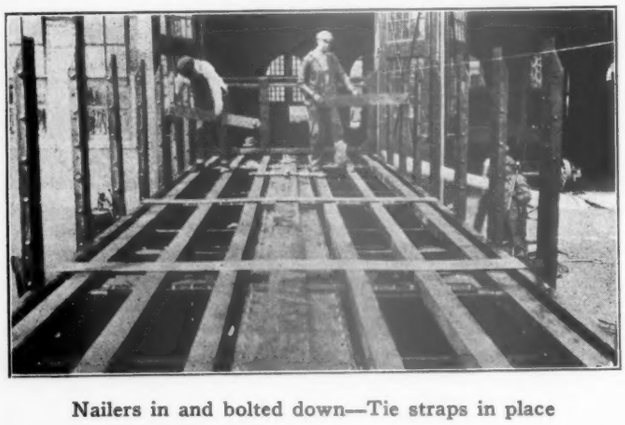
The cars of this series are equipped with Miner A-24-S friction draft gears and but few of the gears have received attention since application. After removing the

couplers and draft gear, it was decided to replace the old Simplex couplers with A. R. A. type "D" couplers and it was found that the gear on one end of the car had been recently worked and did not need attention. The other end, however, needed a new barrel, and the assembling of a new barrel and gear, which was planned to be done by the apprentices, was not carried out because no new barrels were on hand. A gear already assembled was used.

Westinghouse type "K" triple valves and centrifugal dust collectors are standard on these cars but this car came in without a dust collector and with a New York triple valve. It was necessary to make the proper repairs on these parts. The brake pipe was in fair condition and only a few fittings were necessary. Two repaired air hose and two repaired angle cocks were applied and the car was tested and found satisfactory except for the piston travel which was adjusted to the proper length.

A programmed A. F. E. on these cars calls for the application of new needle beams and side stakes. Inspection showed that the two left hand needle beams should be renewed; both end sills required straightening, and one new end sill cover plate was necessary.

Using the Red Devil rivet cutters, the old stakes, needle beams and bolsters were cut out. In some cases it was necessary for one of the apprentices to cut out rivets with an acetylene torch. The four sections of the new body bolsters and the two needle beams were first placed and fitted up for riveting. Then the sixteen intermediate side



Nailers in and bolted down—Tie straps in place

stakes and four needle beam side stakes were placed and fitted up for riveting. After all these were riveted, the end sills were straightened and one new end sill cover plate fitted up and riveted in place.

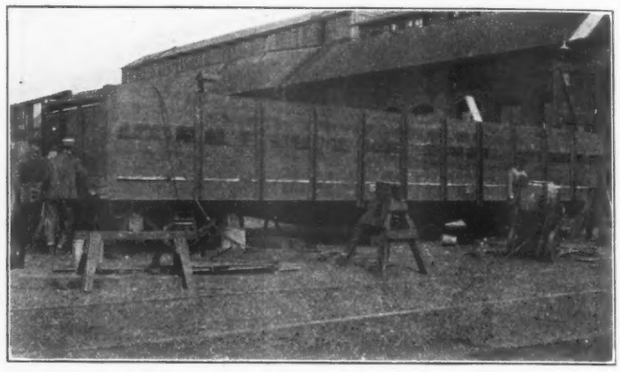
As soon as the steel work was completed, the underframe was spray painted, the nailers bolted down and new decking nailed down. One end of the car was then lowered on its truck. The side boards were bolted in place, being pulled down by a hook and chain running over the top angle iron. While the side boards were being applied, the end boards were fitted in place. The bolt holes in the side and end boards were drilled with an air motor and the nuts were run up by hand. The other truck was then put in place, its application having been delayed due to the necessity of re-driving some tie bar rivets.

As soon as the side and end boards were fixed in place the miscellaneous items such as grab irons, brake steps, coupler pin lifter, etc., were applied and the car was ready for painting. The side and end boards had received one coat of paint prior to application and the car was given another coat of paint the afternoon the mechanical work was completed. A third coat of paint was sprayed on the next day and it was allowed to dry a full day before the stenciling was applied.

Log of repairs

1—Time of start	8:15 a.m.	May 11
2—Air brake equipment and piping removed	8:30 a.m.	May 11
3—Side stakes cut off	8:45 a.m.	May 11
4—Trucks out—car on horses	9:00 a.m.	May 11
5—Draft gear dropped	9:30 a.m.	May 11
6—Bolsters and needle beams cut out	11:00 a.m.	May 11
7—Draft gear applied	2:30 p.m.	May 11
8—Bolsters and needle beams applied	3:00 p.m.	May 12
9—New stakes applied	3:30 p.m.	May 12
10—Trucks ready for application	3:30 p.m.	May 12
11—Trucks under car	8.30 a.m.	May 13
12—Nailers bolted in	2.30 p.m.	May 13
13—Decking down	4:00 p.m.	May 13
14—Air brake equipment applied	10:30 a.m.	May 14
15—Air brakes tested O. K.	1:15 p.m.	May 14
16—Side boards in place	2:30 p.m.	May 14
17—End boards in place	3:00 p.m.	May 14
18—Safety appliances on	3:00 p.m.	May 14
19—First coat of paint on	4:00 p.m.	May 14
20—Second coat of paint on	9:15 a.m.	May 15
21—Stencilling completed and car out	10:30 a.m.	May 16

Under the standard schedule for determining the classification of freight car repairs, car 27,125 received Class



Side and end boards in place ready for drilling and bolting

1 repairs, which required the following operations:

A—New roof.
B—New siding complete.
C—New deck complete.
D—Two or more longitudinal sills.
E—Posts and braces renewed complete.
F—Side plank on gondola cars renewed complete.
G—Steel longitudinal sills two or more straightened or renewed.
H—100 or more rivets renewed.
I—Repaint and stencil complete.

Note—Necessary air brake and truck repairs must be made to secure this classification.

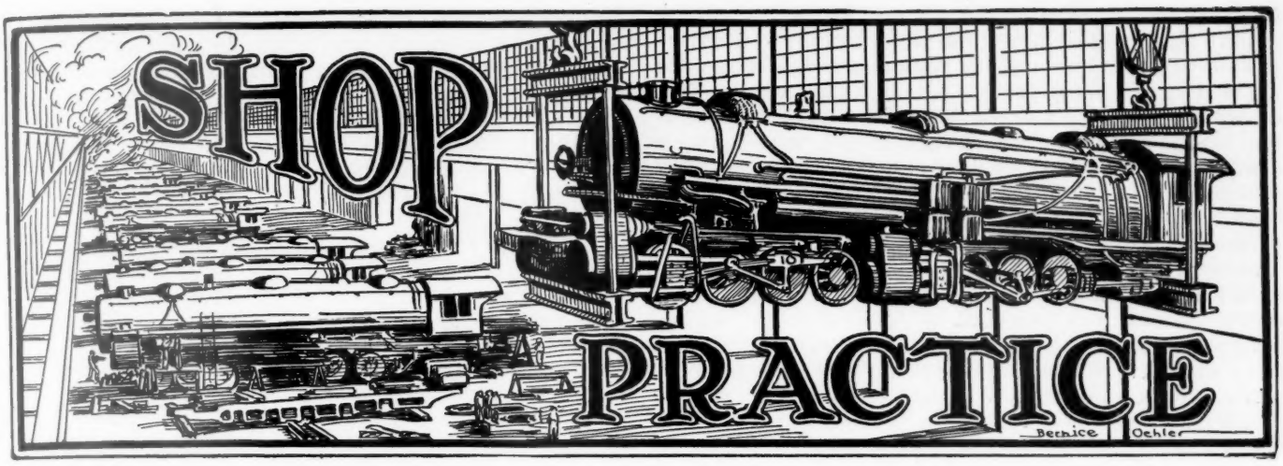
Form 505 report of repairs incorporated in this report

Stencilling the car

shows in detail the new parts and repair work on the car and the cost, a detail of which is given below:

	Labor	Material	Total
General repairs	$175.76	$668.70	$844.46
Replacing in kind	....	12.76	12.76
Additions and betterments	9.40	14.12	23.52
	$185.16	$695.58	$880.74

The car after being completed was inspected and approved for service.



Distribution of overhead charges in locomotive shops

Cost per hour to operate a machine suggested as accurate basis on which to distribute total overhead costs

By W. A. Jones
London, England

IN considering the question of overhead charges as applied to locomotive shops, three of the outstanding features that have never failed to appeal to the writer have been; first, the vague notions held in many cases as to what such charges consist of; second, the high proportion that such charges form of the total cost of a locomotive; and third, the varied and diverse methods by which they are included in the accounts.

Equally with his fellow engineers in other lines of business, the locomotive engineer cannot fail to have at least some interest in the cost of his product and, at the risk of being considered too elementary, it may not be unfruitful if I refer somewhat lightly to these three points. Before doing so, however, it will not be inopportune at this stage to record an opinion freely expressed to the effect that accuracy in costs is by no means so important in the locomotive industry as in those branches of industry where competition is more keen. With this view it is difficult to agree, since the necessity for reducing expenditure has never been more strongly urged on railway executives than it is at the present time. This has led to a number of cases of work being given to outside repair shops that have always been carried out in the locomotive shops. It needs no emphasis to show that the locomotive shops that are able to produce and substantiate the costs of production will be in a much stronger position to meet competition of this nature.

What overhead charges consist of

Reverting back then to the first of these points. Overhead charges may broadly be considered as every item of expense pertaining to the running of a works other than the actual material used, and the direct wages expended, on productive orders. As an example, an operator turning up a pair of drivers will have a definite price paid him for his labor and which will, as a matter of course, be debited as a direct charge against the cost of the wheels. The upkeep of the lathe, apart from the original capital outlay involved in its provision, use of power, cost of supervision, etc., all have to be reckoned with and fall under the heading of overhead charges.

Of the second point, it may be a matter of surprise to learn that in a self-contained locomotive shop making its own castings, forgings, etc., the overhead charges not infrequently, amount to no less than 40 per cent of the gross cost of a locomotive. At the same time we must consider the heavy and expensive nature of the plant necessary for the production of locomotives. In a recent case of an order going through a large locomotive works for a number of 4-6-0 superheater passenger locomotives, the total cost of which amounted to approximately $25,000 each, the overhead charges worked out at $9,750 each. When it is realized that this sum is higher by about 50 per cent than the cost of raw material, the importance of not only a true understanding, but the necessity for a close watch on such expenses will be readily appreciated.

Reference to the third point; viz., the allocation of such charges, may reasonably be left to a later stage and, without further introduction, let us consider the main items of expense that are normally classified under this heading. These are:

1—Cost of power.
2—Rent and rates of buildings, together with the lighting and necessary heating.
3—Maintenance of the plant.
4—Maintenance of buildings.
5—Depreciation.
6—Clerical and supervisory staff.
7—Laborers.
8—Transport charges i. e., cranes, yard locomotives, etc.

Reviewing for a moment our previous example of an

operator turning a pair of drivers, he will doubtless require among other things, the use of a crane to put them in and out of his machine, the assistance of laborers, while the wheels will most probably be brought into the shop on trucks drawn by a works locomotive. All these services have to be paid for and require debiting in as equitable a manner as possible. In many establishments, it is the custom to total these expenses and charge them to the costs as a percentage of the direct wages. For a works producing one type of product this method is doubtless satisfactory, but where the product itself is varied and the tools used in getting out the product are different for each of the various units produced, as for instance a flanging press in the boiler shop and an engine lathe in the machine shop, this method of distributing overhead is both incorrect and misleading in its final figures. There is no more justification for considering that a dollar's worth of labor actually applied to a locomotive part should always take the same percentage of expense than there is for the assumption that a tire mill and a drilling machine cost the same either in initial expenditure or operating cost. With the same reasoning, one would say that the overhead cost of maintaining repair benches and assembly floors is the same as for maintaining and operating machines, obviously an incorrect hypothesis.

Allied to the above method is the one whereby the expenses are charged according to the numbers of hours spent on the respective jobs. This method is subject to the same criticism in that the assumption is made that the overhead expenses have a fixed ratio to the hours spent on a job. Granted that a certain portion of such expenses as supervision, insurance, time clerks, etc., can reasonably be considered as proportionate to the time spent, these in themselves form only a minor portion of the gross charges. Moreover, an employer does not necessarily reduce his clerical and supervisory staff every time business falls off to such a point that he has to lay off some of his men, and the hourly cost would, therefore, vary sufficiently to nullify any advantage claimed. Particularly is this so when this advantage consists chiefly in compensating for the difference in wage rates by substituting hours worked for wages paid.

It will be observed that each of these methods, instead of dealing with the overhead charges as a separate entry, link them up with either the direct wages or the time spent, and any fluctuation in these will at once alter the amount of overhead debited to any particular job. This viewpoint is emphasized by the following illustration. In one locomotive works it was the practice to vary the prices paid for any given job according to the standard rate of the operator engaged on it. Now, since the overhead expenses were debited as a percentage of the direct wages it will be readily understood that there was at times quite an appreciable difference in the total cost of the same article. Exactly the same type of machine was used in each case, and the time the machine was in operation was approximately the same, yet the net result of the methods was that the amount included for overhead was considerably less in the case of the job being carried out by the lower rated man. Further, when quoting for or obtaining the cost of any piece of work, the first step is usually to find the cost of the raw material used, then the direct wages spent on it, and it is surely reasonable to ask that as near as possible we should demand the same accuracy in allocating the overhead charges.

Machine hour rate used as a basis of allocating overhead charges

It was with a view to obviating the above mentioned and similar incorrect assumptions that what is known as the hourly rate method has been developed. The machine hour rate consists of distributing all the manufacturing expenses of a works by a charge to each job of the actual cost of operating the various machines and other facilities used on that particular job. This cost is not an average for the whole plant, but is as nearly as possible the actual cost of maintaining and operating each of the machines, groups of machines, or benches found in the plant.

Referring now to the main headings of expense previously enumerated, the methods of allocating them are as follows:

Cost of power—The horsepower absorbed by each machine was obtained, and the cost allocated in proportion to the total horsepower generated and the cost of production. Under this heading was also included the cost and maintenance of shafting, belting, etc.

Rents, rates, lighting, heating, insurances—The total of these expenses are divided by the number of machines and an equal amount distributed against each. In this way a charge per machine is obtained which is practically the same as the owner of a building would offer if he rented it and supplied the light and heat. It has been advocated that this charge should be debited in proportion to the floor area occupied by each machine but, in practice, the individual amount is so small as certainly not to warrant the extra clerical labor involved.

Maintenance of the plant—Standard order numbers are allocated under which all charges for repairs, etc., are collected and debited to each machine or group of machines according to the actual expense involved.

Maintenance of buildings—These expenses are debited in the same ratio as in No. 2. Included in this heading is also an allowance for depreciation, a factor by no means to be lost sight of.

Depreciation of the plant—For this purpose, the lives of the various machines are estimated, together with their value, usually scrap, at the end of this period. The purchase price of the machine, less the residual value, is then divided by the years of estimated life and an equal amount written off annually.

Clerical and supervisory staff—The total of these expenses obtained are divided equally among the number of machines. An exception is made in the case where a small group of machines require the supervision of a foreman, such as automatics, etc., and the charges are then increased accordingly.

Laborers—Each shop is considered as a self contained unit for the purpose of allocating this charge and the gross expense of each is divided equally among the various machines in each shop. The reason for this is that in such shops as the heavy machine shop, boiler shop, etc., the proportion of laborers is much higher than in those shops where the lighter work is carried out.

Transportation charges—A similar problem presents itself here as in the case of No. 6. The cost of the upkeep of cranes and lifting tackle for each shop is readily ascertained and allocated, but the remainder of the works transportation charge is debited according to the size of the shop and the type of work carried out in each.

It may at first sight appear that the foregoing methods involve a vast amount of clerical work and if an individual rate was made for each item of the plant, this undoubtedly would be the case. To obviate this, machines of approximately the same size, similar in consumption of power, etc., were grouped together for accountancy purposes and a rate used for the whole group. By this means the number of rates was kept within reasonable limits and in actual practice, very few more rates were used

than was the case when a percentage on wages figure was used for each individual shop.

An example of how the hourly machine rate is determined

An important point in connection with the allocation of expenses is that they should be based on a sufficiently long period to ensure correct results. In the particular works under review, these were tabulated every six months, and while means were provided for checking the gross amounts debited against the various jobs with the total overhead charge, very little adjustment and alteration of the rates was found necessary. Naturally, the success or otherwise of these methods depend on the amount of attention given to the division of expenses at the commencement, as unless the first rates are approximately correct, the results obtained will be so misleading as to be in effect their own condemnation. The whole process of fixing a rate will be the better understood by an actual example and for this purpose the case of a heavy steam hammer worked in conjunction with an oil furnace has been selected. This is doubtless a more complicated process than the fixing of a rate for a lathe or a fitter's bench but it will at least, serve to illustrate how a plant of this nature is dealt with. The items in question, including expenses of installation, cost $6,000 and $800 respectively, were given an estimated life of 40 years for the hammer and 20 years for the furnace and engaged the services of four men. For depreciation purposes, the residual value of the hammer was placed at $400 and the furnace as nil. The various expenses were then debited as follows:

EXPENSE	METHOD OF DEBITING	AMOUNT
Power	Proportionate to the volume of steam used; i. e., dia. × stroke of piston.	$915.00
Oil	Gross cost divided by number of furnaces	515.00
Rent, rates, light, etc.	Total for works / Number of units = $112,000 / 1,245 =	90.00
Maintenance of plant, including provision of dies, etc.	Actual cost	945.00
Maintenance of buildings	Total for works / Number of units = $12,700 / 1,245 =	10.00
Depreciation	Hammer $5,600 / 40 × 2 = $70; Furnace $800 / 20 × 2 = 20	90.00
Clerical and supervisory staff.	Total for works / Number of units = $99,626 / 1,245 =	80.00
Laborers	Total for shop / Number of units in shop = $2,700 / 30 =	90.00
Transportation charges	Total for works / Number of units = $11,245 / 1,245 =	9.00
	Total expense	$2,744.00
	Total hours worked during period	1,201
	Hourly rate	$2.25

The term units is the total number of items for which the rates were required. Although the number of separate rates did not exceed 20, the hammer dealt with above forming one of a group, for purposes of illustration the data given herewith is on the basis of an individual rate being required.

From the table it will be seen that the gross indirect cost for operating this hammer and furnace amounts to $2.25 per hour and thus for every job for which this equipment is used, according to the time spent, this addition to the direct wages must be made. The average engineer will scarcely need reminding that this is one of the most expensive portions of the plant to maintain. At the other end of the scale, however, we find that for fitters engaged on detail work at the bench, an addition of 25 cents per hour was quite sufficient to cover the whole of the indirect charges applicable to such labor. In actual practice, experience has shown that the machine hour rate method gave a much closer knowledge and control over overhead charges and enabled us to place a good deal more reliance on the cost figures that were submitted than before. I do not think it an exaggeration to say that so far as accuracy is concerned, everything favors the methods outlined here.

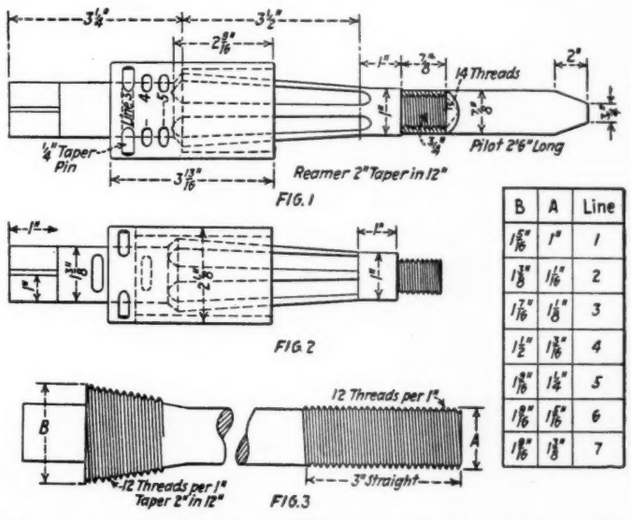
So far as competitive business is concerned, one does not need to think too deeply before realizing that other factors than the actual cost have to be considered when submitting quotations, but at least, it will be admitted that a true knowledge of the costs of production are undoubtedly the safest basis to work on.

In conclusion let me say that all other methods of absorbing manufacturing expenses depend in some way or other on averages, and yet there is no more reason for averaging such expenses than there would be for averaging either the material or the labor costs.

Tool for reaming crown bolt holes

By E. G. Williams

AN improved type of reamer for reaming out crown bolt holes in a boiler before tapping, is shown in Fig. 1 of the sketch. The shank of the reamer has a groove which coincides with a hole drilled in the side of the sleeve. It is a difficult matter for the boilermaker to know where to set the sleeve on the shank of the reamer in order not to make the hole too large to be threaded for the next size of crown bolt. The location of the holes drilled in the side of the sleeve is such as



B	A	Line
1 5/16"	1"	1
1 3/8"	1 1/16"	2
1 7/16"	1 1/8"	3
1 1/2"	1 3/16"	4
1 9/16"	1 1/4"	5
1 5/8"	1 5/16"	6
1 11/16"	1 3/8"	7

Fig. 1—A crown bolt reamer with an adjustable sleeve; Fig. 2—The old method of adjusting the reamer rather than the sleeve

to provide an accurate setting of the sleeve on the shank of the reamer. These holes are numbered to correspond with a line number of a table shown on a reference print, such as shown at the lower left hand corner of the sketch. The letters *A* and *B* of the table refer to dimensions shown in Fig. 3.

The advantage of having the line numbers on the sleeve instead of on the reamer, as shown in Fig. 2, is that the boilermaker is not so apt to make a mistake in locating the proper groove. In Fig. 1 the shank of the reamer has only one groove and the sleeve is set by

inserting the taper pin in the proper hole in the sleeve. With the old arrangement shown in Fig. 2, the sleeve has only one hole and adjustments are made by slipping the taper pin through one of the grooves on the reamer shank. It is comparatively easy to make a mistake by this method because the sleeve conceals the grooves.

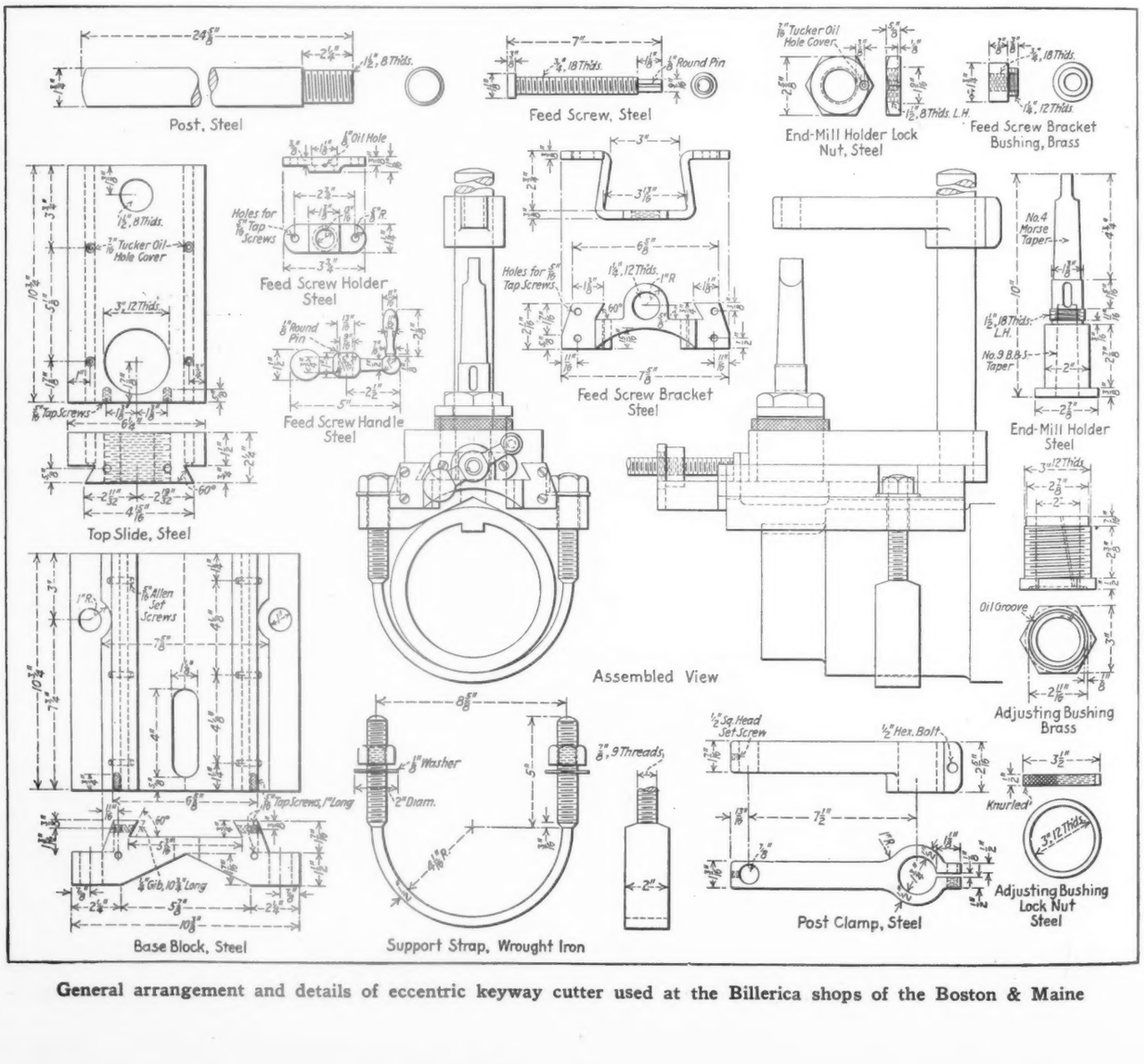
In the case of tapping holes for crown bolts, one tap is made for each line size and it is supposed to be run in flush with the sheet. This procedure, however, is not practicable for reamers as each one would be undersize after the first time it was sharpened. With this device it is only necessary after sharpening to fill the grooves on the reamer shank by electric welding and grind out a new groove to suit the sleeve.

Device for cutting keyways in eccentric pins

ONE of the troublesome jobs in connection with locomotive repair work is the cutting of new or the dressing up of old keyways in eccentric pins. To save time and labor in doing this work, there has been developed at the Billerica shops of the Boston & Maine an air operated portable key seat miller as shown in the illustration. The standard Morse taper shank is provided for attaching an air motor directly above the milling cutter. The motor is held firmly in place by a clamp attached to a 1¾-in. steel post. This arrangement eliminates vibration of the machine and gives a more smoothly milled keyway.

The end mill holder fits in the Morse shank. Fitted around the top of this holder is a steel adjusting bushing which passes through the top slide. The end mill is set to the proper depth of the keyway with this bushing and then maintained by setting the knurled lock nut. The feed is governed by the feed screw and handle at the front end of the device which moves the top slide in the base block parallel to the center line of the axle.

The tool is fastened to the axle by a ½-in. by 2-in. wrought iron U-shaped strap and two ⅞-in. tightening nuts, which draw the strap tight against the underside of the axle. The V-shaped surface of the base block of the tool provides for bringing the cutter on the center line of the axle. Provision is made for taking up all possible wear in the guides by two gibs which are adjusted by set-screws.



General arrangement and details of eccentric keyway cutter used at the Billerica shops of the Boston & Maine

Causes and prevention of pitting in locomotive boilers*

By C. H. Koyl
Engineer of water service, C. M. & St. P., Chicago

FOR many years the study of the cause of boiler pitting was handicapped by a confusion of terms between chemists and boilermen, the word cause meaning one thing to the chemist and quite another to the boilerman. The chemists were seeking for the cause of corrosion of iron, meaning by the term corrosion not only pitting and grooving in boilers but the rusting of iron in general. They sought not so much the physical causes which lead up to corrosion as they did the chemical conditions under which it takes place. They had in succession the oxide theory, the acid theory, the electrolytic theory, the biological theory, and others; but in 1922, by a continuous series of eliminations, they were finally able to agree that corrosion takes place only under water, or at least in the presence of moisture, and that its cause, or the chemical condition under which it takes place, is the presence of hydrogen ions in the water.

On the other hand the boilerman, who knows little about hydrogen ions, wants to know whether pitting is due to something in the boiler feed water, and if so, what; or to the kind of metal of which the boiler is made; or to the temperature of the feed water, or to the number and location of the injectors, or what not; always meaning by the word, cause, something under the control of the man who made the boiler, or of the man who runs it.

Accepting the statement on which all leading chemists have agreed, that pitting can take place only in the presence of hydrogen ions in the water, there yet are two distinct methods by which water becomes charged with hydrogen ions—first, by adding acid; second, by electrification. This tallies exactly with our statement of last year, founded on observation, that there are two kinds of pitting in locomotive boilers, one due to acid and the other due to electric action. But, for the boilerman, there are seven or eight conditions of water or metal to be guarded against under these two general headings.

Pitting caused by acids

Pitting by sulphuric acid, which in this country can best be observed in the vicinity of the eastern coal mines, is very characteristic in locomotive boilers. It always starts about the firebox, where both iron and water are the hottest. It shows its first effect where the surface of the metal has been weakened by bending, punching or heavy hammering, and gradually works forward, so that in the course of time it may reach the front of the boiler. Therefore, from our point of view, water contaminated by the eastern coal mines is to be avoided as one cause of pitting.

Water from swamps and stagnant ponds, and decomposing sewage, none of which are acid in the cold, will yet pit boilers because they are converted to acids by the heat of the boiler. Therefore, to the boilerman, water from these sources are to be avoided as a second cause of pitting.

When the acid in the water is very weak, it has been noticed that the only parts of the boiler affected are those where the smooth surface of the metal has been broken or weakened by rough handling. It may be by scratching a flue as it is worked through the flue sheet; it may be by excessive rolling near the flue end; it may even be by rusting in the open air; but whatever the cause of breaking the hard smooth finish on the steel, it is to be avoided as a third cause of pitting.

Every one knows that the chemical action of acid can be prevented by neutralizing the acid by lime and soda-ash before the water goes to the boiler. On the C. M. & St. P. there is some pitting due to the above causes, but not much. Most of our pitting is on the electric order.

Pitting caused by electric action

Electric pitting in locomotive boilers is also very distinctive in character. It commences at the front end of the boiler where the water comes in, and follows the course of the water toward the firebox though the pitting seldom reaches more than half way back. In its early stages it is found only on the three outer rows of flues, on the front belly plate, and on the front ends of the flues near the flue sheet, but it gradually works toward the firebox.

Also, this kind of pitting is found only in boilers fed with water rich in sodium sulphate or sodium chloride, say 20 grains per gallon as the water goes to the boiler. These alkali salts are chemically neutral to iron at boiler temperatures, but are good electrolytes, that is, they make easy the passage of an electric current through the water; and these circumstances are the starting point for the belief that in this case the hydrogen ions necessary for pitting are the result of electric action.

Furthermore, of late years it has been apparent that electric pitting is of very small amount unless there is oxygen in the water. The reason for this is that in electric pitting the atoms of metallic iron must be dissolved in the water, and since water can hold in solution only an infinitesimal quantity of iron the water would soon become saturated and the pitting cease unless something in the water continuously combined with the iron to take it out of the water and leave room for more iron. This something is oxygen.

Causes and prevention of electric pitting

Therefore, for electric pitting there must exist simultaneously three causes or conditions—electric potential from the iron to the water, alkali electrolyte in the water, and oxygen in the water. If we can eliminate any one of these three conditions we can prevent electric pitting.

For practical purposes we may at once give up hope of getting rid of alkali water, because on the Great Plains between us and the Rocky Mountains there are many thousands of square miles with no other kind of water. It is true that I can show you in print, and signed by a famous man, the proposal to evaporate all this water and then condense it for locomotive use; and it is also true that the chemist of a leading railroad proposed about the same time to freeze all this water and store the ice for

* Abstract of a paper presented before one of the Master Mechanics' staff meetings of the Chicago, Milwaukee & St. Paul.

locomotive use. Each method would give us nearly pure water, yet either would cost too much. Therefore our efforts for prevention of electric pitting must be limited to the elimination of either electric potential or oxygen.

It is a known fact that between any two pieces of metal under water there is a tendency to an electric current if they differ in chemical constitution or in physical condition even the smallest amount. Steel is composed of iron and several other elements and under high-speed manufacture cannot possibly be absolutely uniform in texture and in hardness over the surface of even one flue. There are bound to be spots from which small electric currents tend to flow to other nearby spots, and if they do flow, they take atoms of iron with them, and the result is holes or pits in the steel. This kind of action is known as electrolysis, and its cause is inherent in the steel.

Other metals, such as wrought iron and copper, are more uniform in texture than steel, and both have been tested in boilers and found to pit less. But in addition to the greater cost, there are other reasons why neither of these metals has come into general us for boiler sheets or flues.

It has also been found that if an electric battery is carried on the engine, with its positive pole connected to the water and its negative pole to the boiler shell, the water can be kept at a higher electric potential than the metal which eliminates electrolytic currents and pitting is stopped.

But all these more or less expensive or cumbersome remedies have been held in abeyance because it became evident a few days ago that we had not learned all that was to be known about electrolytic pitting. As already stated, this kind of pitting shows principally on the front half of the boiler. But presumably the steel is of the same kind from one end of the boiler to the other, and, if electrolytic pitting were controlled entirely by the quality of the steel, pitting should be uniform throughout the boiler. Also the flues at the hot end of the boiler are held in the flue sheet by copper shims, and if, pitting were due entirely to difference of metal, then steel flues should pit most rapidly in contact with copper; but they do not.

Eliminating oxygen in the feedwater

Evidently the presence of alkali water and of the electrolytic difference of potential between hard spots and soft spots on steel, and between steel flues and copper shims are not enough to produce pitting. It is just as evident that the third and necessary factor is in the water when it comes through the boiler check valve, and is used up when the water is half way back to the firebox. The discovery and proof of this third factor is the key to the prevention of electrolytic pitting.

At first it was thought that a difference of electric potential between the boiler metal and water existed when the water entered the boiler, and might be sufficient to last until the water was half way back, and thus explain pitting on the front half of the flues and none on the back half. This electric charge, positive on the metal, negative in the water, does exist when the water has passed the boiler check valve. It is always present while the injector is in operation, but I have never found it of sufficient force or quantity to account for the pitting in the front half of the boiler. The phenomenon will require further study because it certainly has some effect on the pitting, but I am convinced that it is not the controlling factor.

The one remaining active content of the water as it enters the boiler is oxygen, and we have enough proof now to enable us to say that this small amount of oxygen, one part per hundred of the water by volume and only twelve parts per million by weight, is the factor which insures pitting in the front half of the boiler; and that there is seldom electric pitting in the back half of the boiler because there is not enough oxygen to last.

We have been a long time making this discovery because we all thought that electrolytic potential in the presence of alkali sulphate was enough, and it was only when we separated acid from alkali pitting and found the alkali pitting is confined to the front of the boiler, that we were led to study the influence of oxygen in this kind of pitting. The proof is complete when we find that the pressure of an open feedwater heater, which nearly eliminates oxygen, is sufficient practically to stop pitting in stationary boilers. Feedwater heaters for locomotives are new in the world but they are in successful use, and some of them are of the open type so that the oxygen can escape while the water is being heated. On a locomotive equipped with such a heater we have conducted a series of daily tests for two months, and find that on the average, 80 per cent of the oxygen is eliminated.

A locomotive feedwater heater saves 10 per cent of the fuel and water, and pays for itself in a year or so; and it will not be any added expense to get rid of oxygen and thus prevent nearly all electric pitting. Therefore, I say with confidence that the days of electric pitting in the Northwest are numbered.

Cleaning triple and distributing valves with kerosene*

By H. G. Myrick
Air brake foreman, Chicago & Alton

AFTER a number of years experience in air brake repair work, the writer has seen the process of cleaning feed valves, distributing valves and triple valves develop through several stages. Both gasoline and kerosene have been used quite extensively and at the present time steam seems to be the most popular. However, for most practical purposes the writer prefers to use kerosene, or what is generally known as coal oil.

Unless gasoline is used with care and the "fire is cut" with engine oil or some other substance, it will blister the hands and arms of the workman. It is also considered to be a fire hazard and, furthermore, its cost is greater than kerosene. On the other hand, it does the work in a satisfactory manner, as it cuts the grease which often accumulates in the main piston bushing and various movable parts of a triple valve. Gasoline also performs the work much quicker than kerosene and it evaporates entirely when air is used to blow out the triple valve after it has been washed. Gasoline will evaporate if by any chance some should be left in the triple valve after it has been assembled and then forced into the test rack during mounting and testing. Kerosene tends to accumulate in the pipes, joints and elbows of the test rack which deposits the graphite lubricant behind fins and in crevices.

Steam is about as dangerous as gasoline on account of the liability of the workman being scalded. Triple valves have rubber and leather gaskets which will not stand the heat of live steam. In order to clean a triple valve it is necessary to remove the check valve case and the cylinder caps, and replace worn-out gaskets, including the rubber seat in the emergency valve. It is, therefore, impossible

* Abstract of a paper read before the St. Louis Air Brake Club, December 12, 1924.

to clean triple valves with steam in the same manner as one would clean the feed valve on a locomotive.

Proper facilities must be provided in order to use steam for cleaning purposes. Due consideration should also be given to the fact that considerable time is consumed in steaming out, cooling and extra handling. If the work is done in a small room, steam will cloud the room, making it unsafe to work in. In repair shops where from 30 to 40 triple valves are being handled each day, the problem of eliminating extra handling is an important one. Tests have shown that the steam does not loosen any of the bushings; but instead of having a dry heat, a wet heat like boiling water will result.

Some men will go to extremes in using kerosene and get so much oil soaked into the casting that it is practically impossible to blow it out. It works up into the slide valve bushings, cutting the dry graphite lubricant, which eventually gets into the test rack.

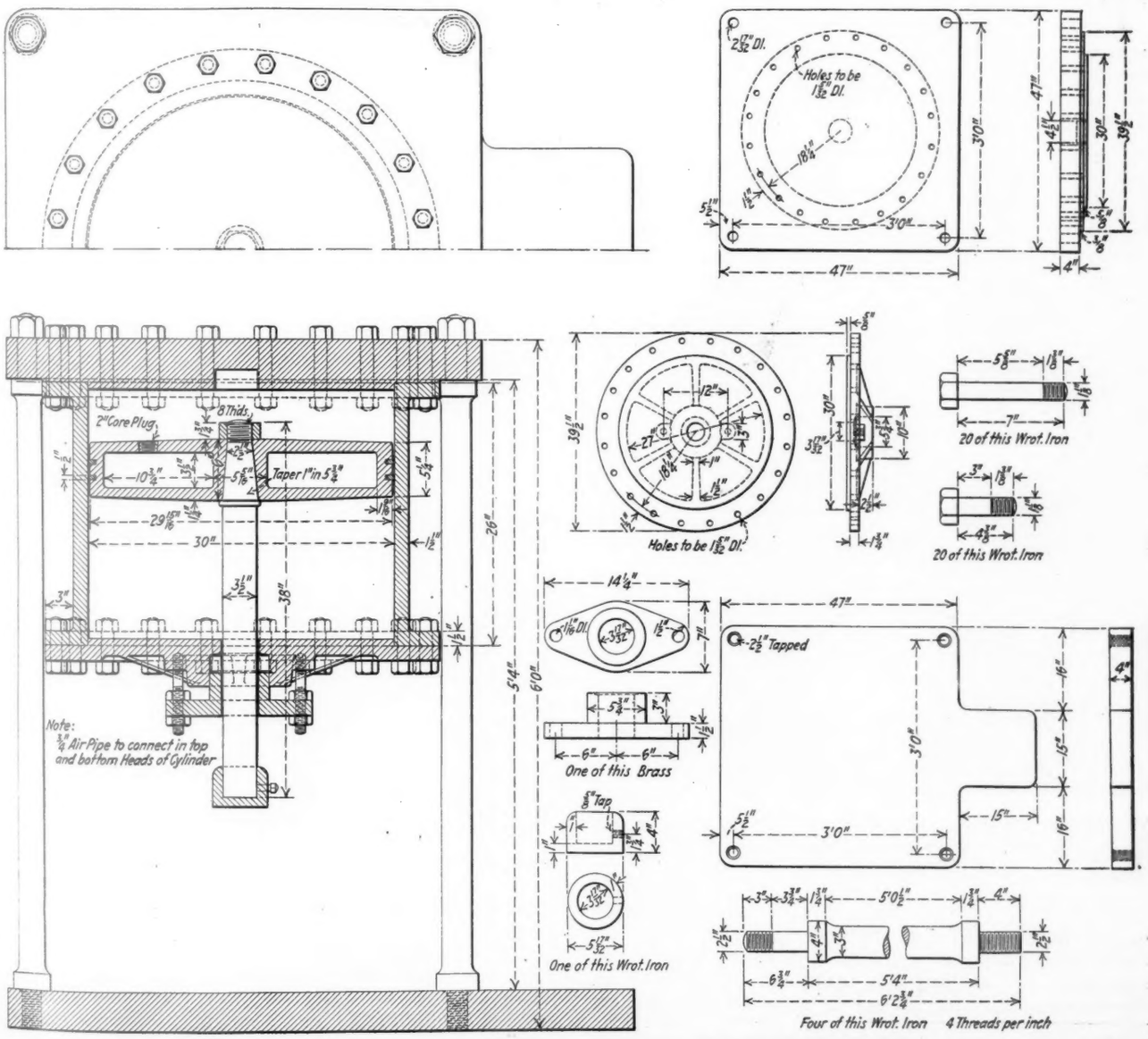
It has been found that by using a bucket or tank with sufficient kerosene in it to cover half the piston, that the oil will last the average man for one day. The bucket or tank can be emptied each evening and clean oil obtained the next morning.

A soft rag should be used to wash off all parts placed in the kerosene tank. The triple valve body should be clamped in a wire and sufficient oil squeezed from the rag to clean it out. An oak stick ¾ in. square and 14 in. long should be used to push the rag into the slide valve bushing. It does good work and protects the fingers of the workman. After washing, wipe out the oil and blow out with air, repeating the operation until the valve is thoroughly dried out. It is good practice to have an oil squirt can filled with gasoline available to flush the air passage in K and L type triple valves.

Pneumatic press for driving box shells

By E. A. Miller

A CONVENIENT type of pneumatic press that can be used to good advantage for such work as pressing in driving box shells or rod bushings is shown in the drawing. Its construction is comparatively simple, con-



Drawing showing the assembly and various parts of the pneumatic press

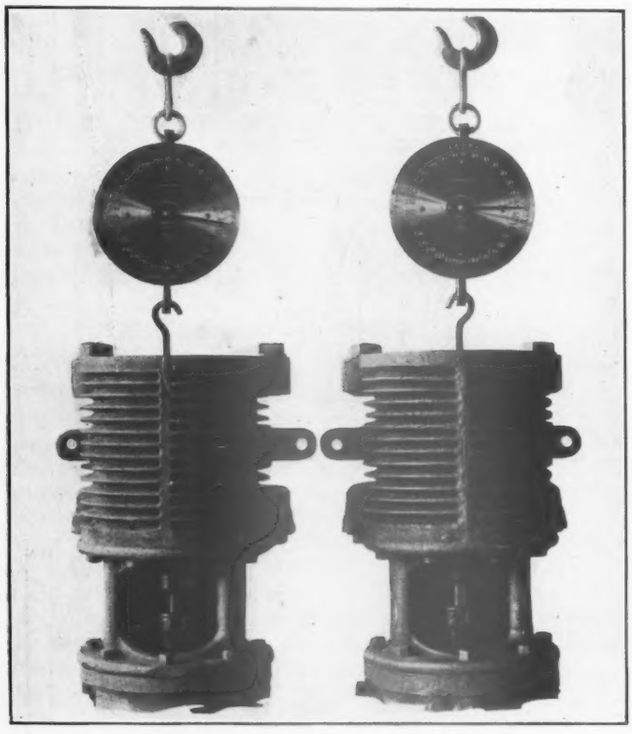
sisting essentially of a 30-in. by 24¾-in. air cylinder, a plain cast steel base and top casting to which the air cylinder is bolted. The top casting is supported on four columns, 3 in. in diameter and 5 ft. 4 in. high.

Power is furnished for pressing by admitting compressed air above the piston. Connections are provided in the top and bottom heads of the cylinder for a ¾-in. pipe which is connected to the shop air line through two control valves, one of which is for lowering the piston and the other for raising. The piston rod is 3½ in. in diameter and is secured to the piston in the usual manner, except that the shank is tapered 1 in. in 5¾ in. This distributes the pressure exerted on the piston over a greater area than would otherwise be the case if the shank were turned without a taper and the pressure of the piston were exerted entirely on the shoulder of the piston rod, which extends down through the bottom head where it serves as the ram. A shoe of wrought iron is placed on the lower end of the ram to take up the wear.

Air compressor maintenance*

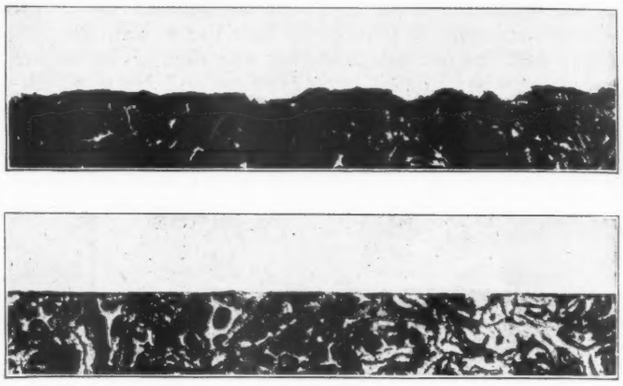
THE methods of maintaining locomotive air compressors at railroad shops and enginehouses are important because on them depends the efficiency and subsequent service life of the compressors as well as the cost of the maintenance work itself.

At the present time worn cylinders are commonly reconditioned by boring, although a considerable number of grinding machines of different types have been installed within the past two or three years and have proved successful for handling this operation. When ground, the resulting cylinder surface is much superior to that obtained by boring, both in smoothness and accuracy. As the grinding wheel is composed of many thousand cutting particles it removes the necessary metal with a minimum pressure against the cylinder walls. The comparison between bored and ground surfaces afforded in two of the illustrations is significant. The superior smoothness of the ground surface means a correct seating of the rings from the start. Owing to the light pressure of the wheel against the cylinder walls, the grinding process is not affected by thick and thin walls, hard spots, etc., with the result that grinding will produce a straight and round hole without cutting away an excessive amount of stock. This minimum removal of stock means that air compressors may be reconditioned many times by grinding than is possible by boring.



The ground compressor (right) showed 11 per cent less pull required to lift the piston, ring and rod assembly than the bored compressor (left)

Although grinding is generally admitted to be superior to boring, the factor of cylinder misalinement may still be present to detract from the highest air compressor efficiency. The present common method of boring cylinders necessitates their removal from the center castings. Each cylinder or pair of cylinders is set up and bored separately and assuming that accurate centers are obtained in boring, the cylinders may be slightly out of line when reassembled either to their original or some other center casting. It should be borne in mind that taper and out-of-round conditions in the cylinders accentuate misalinement as does also the failure to draw the gasket down evenly. Misalinement not only adds to the internal friction but makes it necessary to exert considerable pressure on the stuffing box packing to prevent leaks. The correction of cylinder misalinement in air compressors is proving a real problem on some roads which have been compelled to adopt strenuous methods to secure accuracy in this detail of maintenance. The effect of cylinder misalinement is clearly shown in the drawing.



Unretouched microphotograph of cylinder wall section, bored (above) and ground (below) which shows the smoothness obtained by grinding

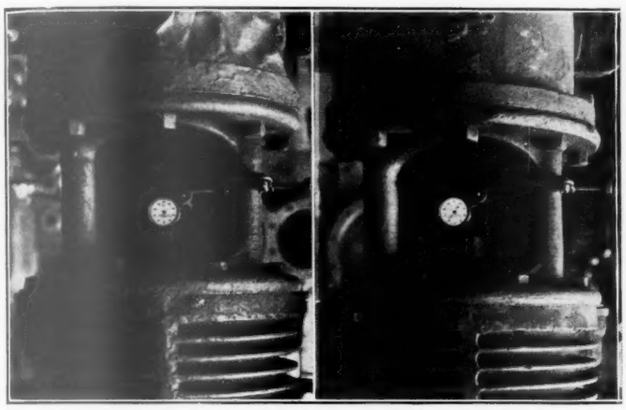
Air compressor tests

The following tests were conducted, using Westinghouse 9½-in. air compressors. Both bored and ground pumps were reconditioned to the same oversize with the same piston clearance and ring gap. The bored compressor was reconditioned in a railroad shop and when measured with inside micrometers showed 0.004 in. out of round and 0.009 in. taper in the steam cylinder, while the air cylinder was 0.008 in. out of round with 0.011 in. taper. In the ground pump both the steam and air cylinders were measured showing that they were straight and round within 0.001 in. New pistons and rods were used, the pistons being turned 0.009 in. smaller than the

* The facts pertaining to the tests described in this article were obtained from the Micro Machine Company, Davenport, Iowa.

smallest diameter of the cylinder, or 0.001 in. for each inch of cylinder diameter.

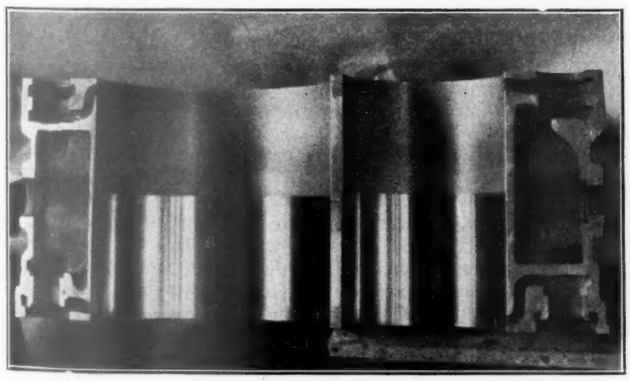
In testing for alinement the pistons were assembled in the compressors without rings and an indicator was clamped to the center casting playing on the piston rod as illustrated. In pushing the pistons back and forth the indicator showed a misalinement of 0.010 in. on the bored pump and less than 0.001 in. on the ground pump. The piston, ring and rod assembly of both compressors weighed 57 lb. The pistons, rings and rods were then assembled to the cylinders, piston rod packing and stuffing box nuts being omitted. With the compressors in a vertical position a spring scale was attached to the pis-



How the test for cylinder misalinement was made

ton and a steady upward pull exerted, also shown in one of the illustrations. The bored compressor pistons pulled at 82 lb. (or a frictional pull of 25 lb.) and the ground compressor pistons pulled at 73 lb. (or a frictional pull of 16 lb.). This showed a difference of 9 lb. or 36 per cent less frictional resistance for the ground compressor.

The compressors were tested on a standard railroad test rack under pressure. In order to obtain conditions as nearly equal as possible the same steam heads were used on both compressors. The steam line carried a pressure of 135 lb. The initial test was conducted to determine the highest pressure that could be reached with



Surface comparison of bored and ground sections

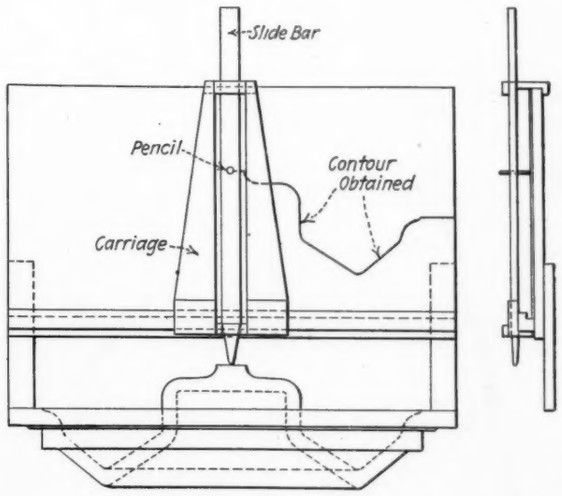
the orifice closed, and the number of strokes necessary to maintain this pressure. The ground compressor reached a maximum pressure of 120 lb. and maintained this pressure with 19 strokes per minute. The bored compressor reached a maximum pressure of 115 lb. and maintained this pressure with 38 strokes per minute. This showed a saving of 50 per cent in strokes with the ground as compared with the bored compressor as well as demonstrating an ability on the part of the ground compressor to attain a higher air pressure.

The second test was conducted to determine the necessary strokes and time required to pump up to 100 lb. pressure with the air tank empty and the orifice closed. The bored compressor required 376 strokes and 4¾ min. while the ground compressor required only 320 strokes and 4½ min. The ground pump showed a reduction in strokes of 14.7 per cent and in time of ¼ min.

A third test was conducted with the 11/64-in. orifice open. The ground compressor reached a maximum pressure of 55 lb. in the drum and maintained this pressure of 104 strokes per minute. The bored compressor reached a maximum pressure of 50 lb. and remained at this pressure with 108 strokes per minute. During the test it was necessary to tighten the stuffing box nuts three times to prevent leakage with the bored compressor but this was unnecessary in the case of the one with ground cylinders. In order to ascertain the comparative difference in pressure of packing on the piston rods the heads were removed and it was found that the piston in the ground compressor could be lifted easily by hand and would drop by its own weight, while the piston in the bored compressor could not be removed without the use of a chain block.

Checking contours of cylinder head castings

SOMETIMES an engineman forgets that the cylinder cocks will let water out of the cylinders more economically than by way of the front cylinder head. There are also occasions when the rod gang in the repair shops



Apparatus by which inaccuracies in the contour of a cylinder head casting can be determined

makes a mistake and when the cylinder head is blown out, it is a difficult matter to place the blame where it belongs. A number of investigations have shown the existence of interference between the piston and cylinder head, due to incorrect contours of the cylinder head casting. In order to protect the stores department from accepting castings having wrong contours, the mechanical engineer's office had the pantograph arrangement shown in the sketch made so that the contours could be properly checked.

This device, which was made in the pattern shop, con-

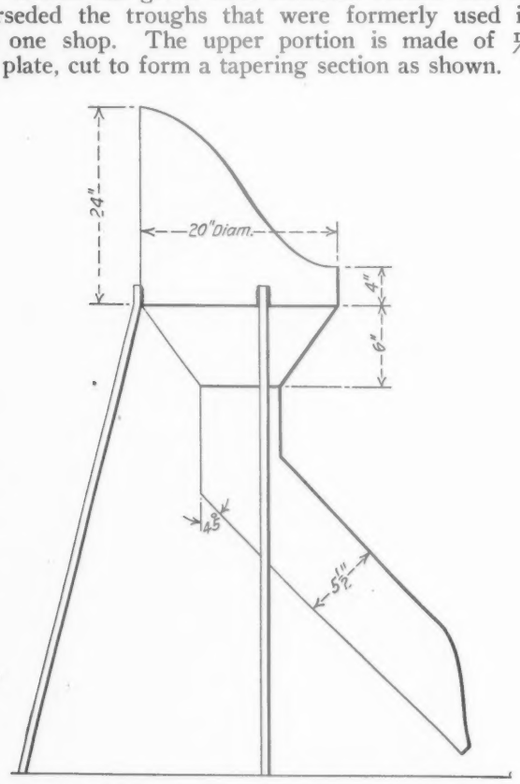
sists of a base board to which a sheet of drawing paper is fastened, and a carriage equipped with a slide bar and pencil. The carriage, shown in the sketch, carries the slide bar which moves vertically in its guides. The lower end of the slide bar is tipped with a metal point which is kept in contact with the contour of the casting as the carriage is moved while the check is being made. A pencil for scribing the contour line on the drawing paper is inserted through a hole located near the center of the slide bar.

The carriage is free to move in a horizontal direction only and the slide bar can be moved only in a vertical direction. As the carriage is moved across the face of the base board, the slide bar moves up and down as guided by the contours of the cylinder castings. These combined movements give the resulting contour line which is scribed by the pencil on the drawing paper.

Wash-out trough for the enginehouse

By Joseph Smith

THE locomotive wash-out trough shown in the sketch has given such excellent results that it has superseded the troughs that were formerly used in at least one shop. The upper portion is made of ⅛-in. steel plate, cut to form a tapering section as shown. This

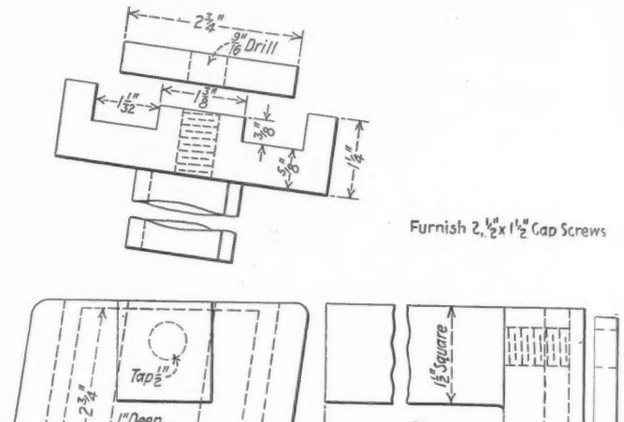


The use of this trough when washing out a locomotive has added materially to the comfort of the men

is welded to a section shaped like the frustrum of a cone while the outlet portion is made from a discarded superheater tube which is cut for the shape shown and welded to the funnel. The length of this trough can be made to suit local conditions, but it should be long enough to extend over the side of the engine pit. The trough is supported on three legs made of ¾-in. round iron, flattened out at one end and welded to the body of the trough. Two of these troughs are required, one at each front corner of the mud-ring.

Double tool holder for grooving locomotive tires

THE usual practice of cutting the tire grooves in a segmental ring is to machine them one at a time on a boring mill. In order to reduce the time required for this operation, a double-tool holder has been designed which is shown in the accompanying illustration.



Tool holder for cutting two grooves at one time in a locomotive tire

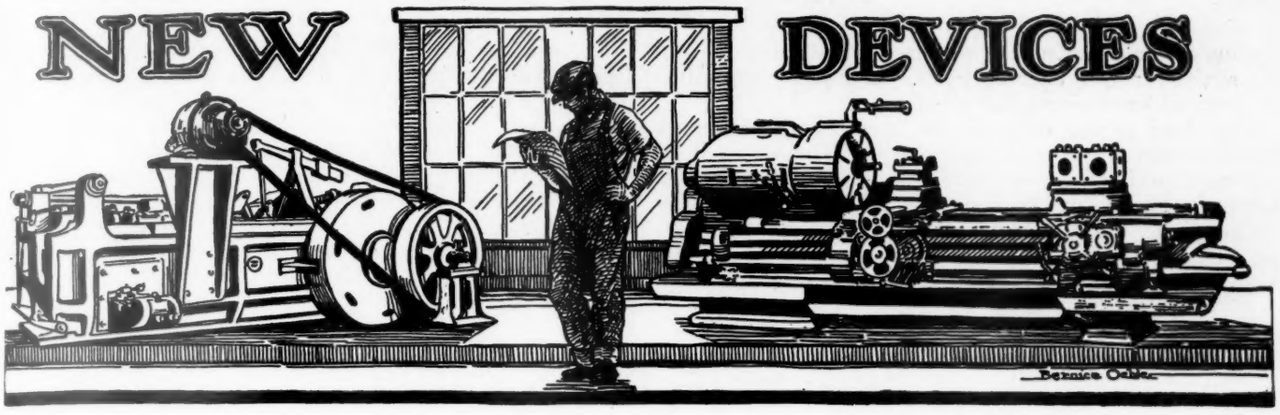
It will be noted that it is simple in construction and that it is so designed that the cutting tools are securely held in position. This allows the use of any high speed cutting tool which facilitates the depth and speed of cut.

DeWitt Rapalje, engineer of the Railroad Insurance Association, New York City, believes that many "no smoking" signs have, under existing conditions, about the same deterrent effect on railroad employees as they would have on a locomotive if tacked up on the front end of its boiler. In a paper prepared for the National Fire Protection Association, he says:

Locomotives often do a lot of smoking, but there is a more promiscuous smoker and a greater fire hazard on the railroads, and that is the careless employee. Matches and smoking, among the known causes reported annually, average over 300 fires and about half a million dollars of railroad property burned. No doubt many of the fires of "unknown" origin may belong in this group. Efforts to reduce this hazard which consist only of posting "No Smoking" signs at every conceivable point are frequently misdirected and are of about as much value as a fuel economy campaign would be which consisted of tacking a "No Smoking" sign on the front end of every locomotive.

Railroad employees generally have rough and dirty work to do as their daily task and efforts to convert them all to the non-smoking class are bound to meet with scant success. Most of them want to smoke, and they do so regardless of all the signs.

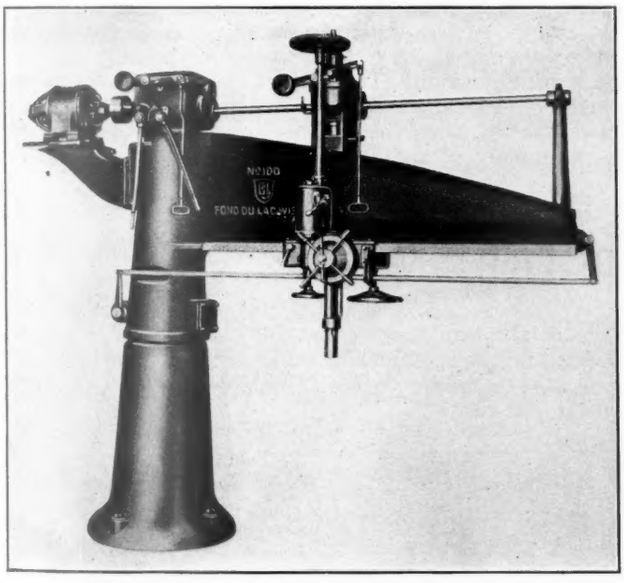
Smoking is a general habit and should be provided for by managements for employees the same as facilities are provided for passengers who smoke on trains and at stations. Provide safe and suitable smoking rooms and this serious fire hazard can be controlled. Rules against smoking can be enforced if they are applied only at the hazardous spots. The railroad record-room is a case in point. Fire inspectors are constantly reporting evidence of smoking in the typical record-room where large quantities of paper files are stored. This room generally affords one of the worst places for a cigarette butt or burning match to be left to its own inclinations. The file clerks smoke in these rooms because they can do so there without detection, while the office in which smoking might be safely indulged is filled with smoking prohibited signs.



Six-foot plain radial drill

THE 6-ft. plain radial drill shown in the illustration was designed to meet the present day requirements in boiler, car and locomotive shops. It is particularly adapted for drilling material such as tank and boiler plates. It has been designed to give ease of operation, by a convenient location of the hand wheels, lever, etc., and lower power consumption, because of the short and simple drive connections between the motor and the drill spindle.

The arm is of the hollow, box-type construction and is well ribbed. It has a movement of 360 deg. about the column. It revolves on the column in roller bearings, and a large size ball thrust bearing is used to carry the weight of the arm, thus minimizing the force necessary to move the arm to the desired drilling position. The arm is also provided with a positive opening and closing cam actuated clamp for holding it to the column and is operated by a lever mounted on the head, which is within easy reach of the operator at all times.



Drill press designed for plate work with the control levers centralized

The motor drive is connected to the drive shaft of the speed box by means of a silent flexible Grundy coupling. The motor bracket is of the box type of construction and is adjustable to suit the different motors which may be used. Tapping can be performed on this machine by installing a reversing motor provided with a magnetic brake and control.

The speed box provides eight changes of speed for the spindle. The shafts are mounted on large size ball bearings. The sliding gear system is used to change the speeds and generous size bronze shifter shoes are employed to shift the gears. The gears run in heavy oil and are entirely enclosed by the speed case proper, the cover of which is easily removed for inspection purposes and repairs.

The spindle head is a rigid casting, well ribbed, and having long and narrow guiding ways which insure correct alinement at all times. The head is moved along the ways of the arm by means of an angular rack, worm, and generous sized hand wheel. The head can be clamped to the arm at any desired location.

The spindle is made of high carbon steel and runs in bronze bearings and is liberally supplied with oiling facilities. The thrust is taken by a large capacity ball bearing. The spindle is driven by means of a hardened steel worm and a bronze worm wheel, the worm being connected to the speed box by a shaft having a continuous keyway on which the worm slides. The worm runs in an oil bath and is mounted on ball bearings, one of which is of the double row deep groove type to take the thrust. The spindle proper has a double keyway on which is mounted a hardened steel jaw clutch, which meshes with a clutch fastened to the bronze worm wheel. The clutch on the spindle proper is shifted by means of bronze shifter shoes. The shifting lever for operating this clutch is directly in front of the operator. The entire driving mechanism is enclosed in a dust proof housing. One of the important features of this machine is that the spindle travels directly in the vertical center of the arm. By this construction all twisting strains on the arm are avoided.

The drive to the feed box is taken from the main spindle through spur gears. The drive pinion is made of steel and runs in a bronze bearing and is held in place by means of thrust washers. The driving gear is directly connected to the feed box mechanism. The pinion and gear are entirely housed but are easily accessible.

The feed box is a self-contained unit. The standard drive key construction is used to obtain the different feeds, of which there are six, having a range that is adequate to meet all needs. The changes are made by means of a

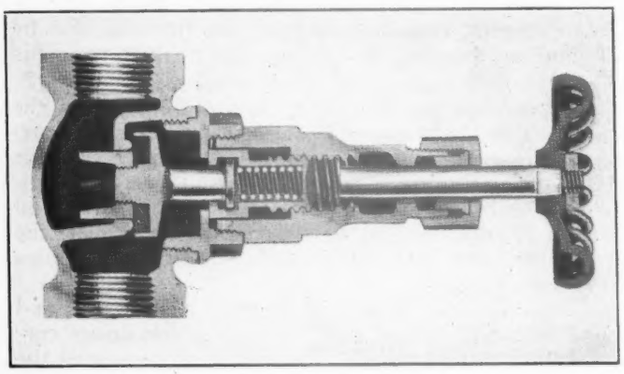
graduated dial showing the various feeds obtainable. All the shafts run in bronze bearings. A positive jaw clutch is provided for disengaging the feed.

The feed to the drill spindle is obtained through a worm, worm wheel, rack and pinion. The worm is of hardened steel and the end thrust is taken by a ball thrust bearing. The worm wheel is of cast iron and runs directly on the pinion shaft. A large friction clutch of the multiple disc type is used for engaging the power feed. A hand hole is provided for adjusting the friction clutch. The two handles of the pilot wheel when pulled toward the operator engage the feed, and when pushed away, disengage it. A hand feed wheel is also provided on the worm shaft. The feed pinion is cut directly on the shaft and is liberal in width and length. The rack is made of steel and securely fastened to the spindle sleeve.

The machine will drill holes in solid steel up to 2 in. in diameter. A 7½-hp., 1,200 r.p.m. motor is recommended. This machine is manufactured by the Giddings & Lewis Machine Tool Company, Fond du Lac, Wis.

Self seat brass valve

THE Ohio Injector Company, Wadsworth, Ohio, has recently received patents on and placed on the market a brass body valve designed for steam working pressure up to 200 lb. The principal feature of this valve is that the seat and disk are always brought into contact and held together by the same pressure, and it is so designed that this pressure can never be great enough to injure these parts. This action is altogether independent of the pressure applied to the hand wheel and it is therefore impossible to destroy the seating qualities of the valve by rough and careless operation. For this reason this valve is particularly adapted to serve where unskilled labor is employed and it also increases the life of the valve seats.



Ohio valve designed for steam pressure up to 200 lb.

Among the points of advantage which are claimed for this valve are that its area is not restricted by the extension of the stem into the seat opening; the valve body is of greater strength owing to the fact that there are only three openings in it. This valve is designed in such a manner that it will function when mounted in any position, and the perfect seating of the valve disk is not dependent on the spring or gravity to insure the disk coming to a seating position. The perfect operation of the valve is said not to be affected by the spring losing its temper or being omitted altogether. This feature is conducive to its continuous operation.

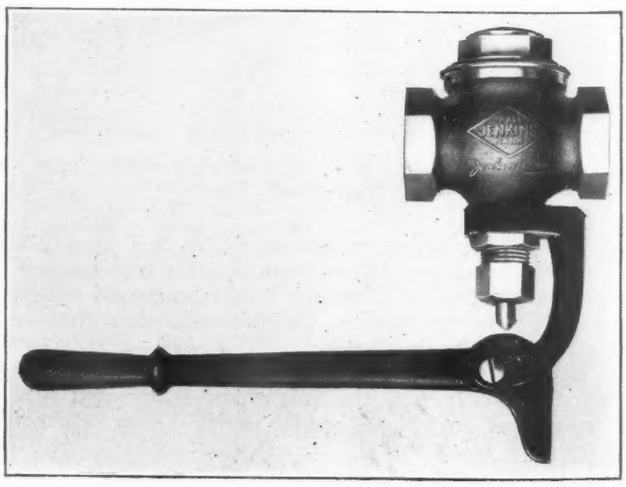
Jenkins rapid action valve

A RAPID action valve designed to fill a need for a valve that can be opened and closed instantly without water-hammer, and that will automatically stay open without the aid of set screws, locking devices or other appliances, is manufactured by the Jenkins Brothers, New York, whose specialty is all types and sizes of valves.

The hand lever, when given a pull of a quarter turn, bears on the end of the spindle which forces the disc off the seat, thus opening the valve. The lever alineing with the spindle positively holds the valve open. A slight pull on the lever, however, will throw it out of alinement with the spindle and the disc is then immediately forced onto the seat. The closing of the disc on the seat is regulated to avoid water-hammer; this being accomplished by the combination of a spring, piston, cylinder and water pressure. The avoidance of water-hammer is always desired in any installation, especially in shops and offices where the noise will annoy those at work.

The valve is made from a bronze mixture and is fitted with the Jenkins renewable composition disc. The spindle is made of steel, the yoke is steel forged, and the lever is enameled. The end of the spindle and the cam on the lever are especially hardened to prevent wear, which increases the life of the valve, which is an important feature in valve maintenance.

There are many uses for a rapid action valve in the modern railroad enginehouses, yards, and shops, it has been used to advantage, for example, on water supply lines in car yards.



Rapid action valve which automatically stays open without the aid of any other device

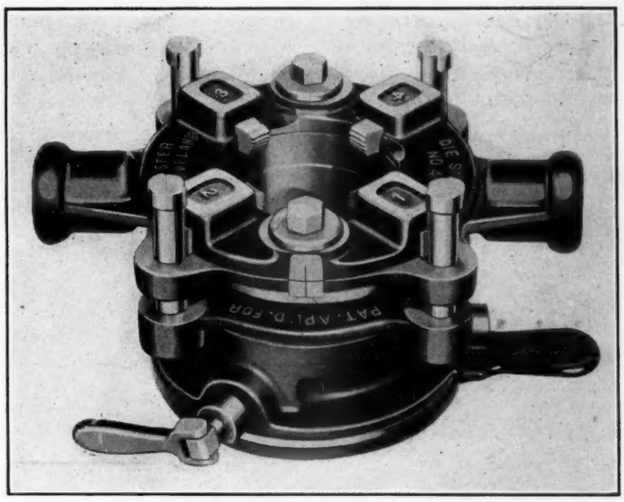
Die stock for cutting pipe threads

AN easy cutting, receding die stock recently placed on the market by the Oster Manufacturing Company, Cleveland, Ohio, has several features of interest. Its capacity is one-inch to 2-inch pipe and it is made in both the plain and ratchet types.

One of the special features of this cutter is the lead on the dies which enables the operator to start them quickly and easily. A scientifically worked out cutting angle or rake brings the efficiency of the cutting edge of the dies to a maximum so that the teeth will tool out the metal with the least amount of pull on the part of the operator.

The die head of the tool is constructed so as to be quickly and easily adjusted to cut oversize or undersize as well as standard threads. The lead screw is protected from dirt and chips by a chip shield. This tends to lengthen the life of the lead screw, which is important to a tool of this type.

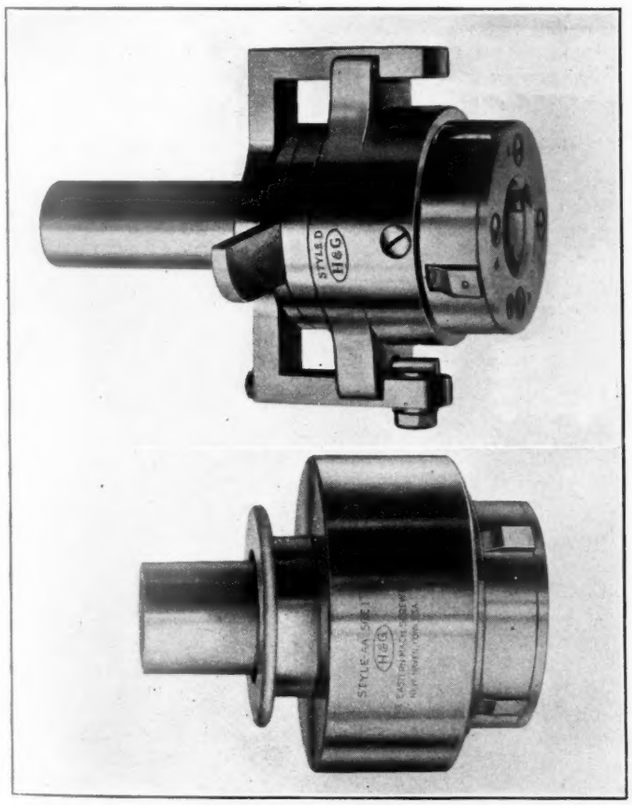
A self-centering chuck is standard equipment with the tool but it can be supplied also with bushings and set screws. The advantage of the chuck is that there are no set screws to adjust or extra bushings to carry.



The Oster easy cutting die stock uses a new type of dies

Self-opening die heads for screw machines

A SELF-OPENING die head for automatic screw machines and for threading on drill presses is the latest development of the Eastern Machine Screw Corporation, New Haven, Conn. Referring to the illustration, the upper view shows the new style AA die head designed for threading on a drill press, National Acme automatic threading machine, etc. The lower photograph shows the new style D double-drive die head especially designed for service on Brown & Sharpe automatic screw machines.



The style AA die head at the left specially adapted to machines where the die rotates and the stock does not—The style D die head at the right is provided with a double drive feature

The style D head is provided with two arms from the floating shank instead of one, which prevents any possibility of the head being thrown to one side, due to the action of threading. Both the arms and the bearing surfaces of the extensions from the shells are ground so that the drive is equally distributed, both to the top and bottom. The head is self-contained in that an accurate adjustment for the length of thread is provided on the upper arm. These heads are designed to provide a wide range of thread specifications and at the same time to simplify the cam layout, set up and general operation of the machine. It is also adaptable to Cleveland automatic screw machines.

The outer sleeve of the style AA head is provided with a spool at the back to take a simple yoke. It is so designed that when the threading spindle is drawn back after a thread has been cut and the backward motion of the yoke arrested by means of a stop, the die head is automatically closed. As the die spindle advances during the threading operation, the length of thread cut is determined by a stop which arrests the forward motion of the yoke, thereby holding back the outer sleeve and causing the die head to trip.

The tripping which is of the pull-off nature is quite sensitive in its operation and makes it possible to govern the length of thread to a small fraction of the pitch. This arrangement provides a safety feature against any possibility of the head starting to thread short bar ends and refusing to let go. Only the simplest form of sliding yoke or fork is required to operate this head which is arranged with an adjustable stop on each side of its travel.

For drill press work, the shanks of the style AA head can be modified to provide the proper standard tapers to fit the spindle of the drill press. The diameter of the thread cut is adjusted by means of a micrometer adjusting screw on the front face of the tool.

Duplex enclosed flood lubricated pump

THE enclosed type of self-lubricating power pump recently placed on the market by the Gardner Governor Company, Quincy, Ill., is a general service pump for boiler feeding, water circulation, pressure boosting, water supply or any other service where a pump is required. With an installation arranged so that the pump can be operated by a float switch or remote control, the pump can be started by merely turning a switch which eliminates most of the attention required by an attendant.

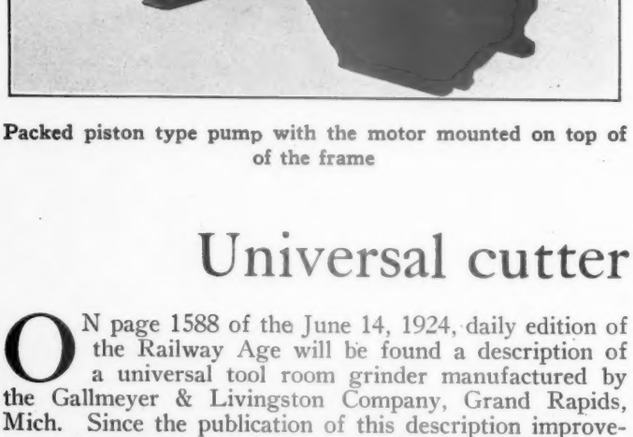
Packed piston type pump with the motor mounted on top of of the frame

All the running parts of the pump are totally enclosed in the crank case which acts as an oil reservoir for the flood lubricating system. Grease cups, oil cups and sight feed oilers have been entirely discarded. The lubricating system is automatic and positive. The main driving gear, partially submerged in oil, delivers the oil through channels to the main and pinion shaft bearings, crank and crosshead pin bearings and crosshead guides. All the working parts are flooded with oil, which insures long life and continued smooth operation.

The type of valve used is determined by the kind of liquid pumped. Medium rubber valves are recommended for cold water service and hard rubber or brass valves for hot water. The brass valves in packed pistons and outside packed pumps are light weight disc valves with a curved web. The oil line pumps have brass wing guided valves seated on a taper.

Universal cutter and tool grinder

ON page 1588 of the June 14, 1924, daily edition of the Railway Age will be found a description of a universal tool room grinder manufactured by the Gallmeyer & Livingston Company, Grand Rapids, Mich. Since the publication of this description improvements have been made on the machine, principally in the addition of a motor driven, wet grinding attachment.



Motor driven grinder provided with a power feed and a wet grinding attachment

The machine is made in two sizes, either of which can be operated from the front or the rear. Transverse, vertical and longitudinal movements can be made from either position. Furthermore, from the front of the machine a choice is offered for longitudinal movement between a rapid action lever handle and a slower handwheel movement. For both vertical and cross feed movement the hand wheels are graduated in thousandths, the graduations being coarse enough to be easily split, if necessary. Pointers with movable set collars, make the reading easy. In service, the machine can be made to perform practically every operation in either of two ways: by either having the spindle head locked in position on the central column and swivelling the sleeve knee, etc., around it, or by leaving the sleeve locked in a fixed position and swivelling the head to the desired position. Individual preference, on the part of the operator, can be the guide in most cases, but in some instances the difference in direction of artificial and natural daylight makes it desirable to take advantage of the opportunity offered for swivelling the knee saddle into the best lighted position and then swivelling the head to the proper position for effecting the grinding job in hand. One setting can be used for daylight and another for artificial illumination and each of them give the desired convenience.

The wet grinding attachment may be added to the machine or not, as preferred. Where cylindrical grinding is to be done, wet grinding is essential and it is desirable for many other jobs. The accompanying illustration shows the machine arranged for cylindrical grinding with the splash guards in place. A copious flow of water is provided from a centrifugal pump with no stuffing boxes or other parts to wear. The pump is driven from the motor shaft in the base on motor driven units, or by a belt from the countershaft on belt driven machines. Water is supplied in large volume but without sufficient pressure to cause splashing. The guards keep the water in the

machine and return it to the tank with its settling chamber ready for further use. The tank can be quickly removed for cleaning.

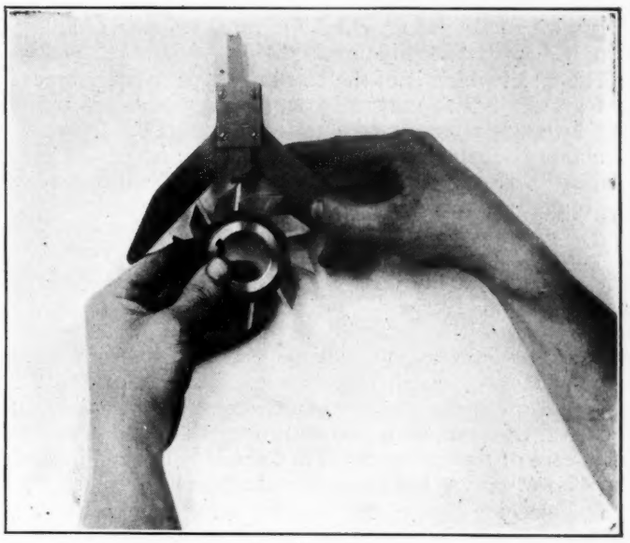
Some of the dimensions of the machine are as follows: Size of table, 5½ in. by 42 in.; longitudinal travel, 18 in.; transverse movement, 10 in.; vertical movement, 10¾ in.; maximum swing, 10½ in. by 26 in.; and maximum distance from center line of the spindle to the table, 10½ in.

Convenient tools for the tool room

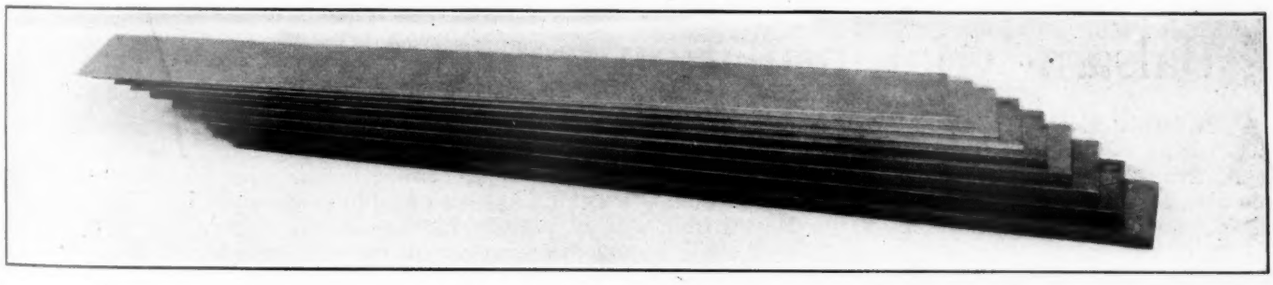
A CUTTER clearance gage and ground flat stock are recent additions made by the Brown & Sharpe Manufacturing Company, Providence, R. I., to its list of hand tools. The clearance gage is a simple device designed for the purpose of aiding in grinding the correct angle of clearance on milling cutters. It may be used for right and left hand cutters and for end mills of all styles. The vee-shape body locates the cutter and holds the gage blade in correct relation to the center line of the cutter. All contact surfaces are hardened and ground. Two gage blades are furnished, each of which is stamped at each end with the diameter of the cutters for which it is intended to be used.

The gage will measure all style cutters from ½ in. up to 8 in. in diameter, and of any width. Its use is very simple. The inside surfaces of the vee arc are brought in contact with the cutter as shown in one of the illustrations, and then the gage blade is dropped on the tooth to be gaged. The cutter is revolved sufficiently to bring the face of the tooth in contact with the gage blade. The angle of clearance in the tooth should correspond with the angle of the gage thus accurately determining whether the cutter teeth are properly cut or not.

The railroad toolroom is often required to make templates, gages and small tools from flat stock. The ground flat stock shown in the illustration is well adapted to this class of work. This stock is now available in three new thicknesses, 3/64 in.; 5/16 in.; and ⅜ in., and in six new square sizes varying from ¼ in. to 1 in. square. New widths can also be obtained from ½ in. to 6 in. in some thicknesses. This stock is made from tool steel, cut and annealed, then accurately ground to thickness. Each piece of stock is 18 in. long.



Method of using the Brown & Sharpe cutter clearance gage



Ground flat stock for use in the tool room

Heavy duty vertical boring and drilling machines

THREE sizes of heavy duty vertical boring, drilling and milling machines have recently been placed on the market by Baker Brothers, Inc., Toledo, Ohio. Size No. 525, which is shown in the accompanying illustration, is the largest of the three. In the next size, the machine has a 24-in. gap and a swing of 48-in. which makes it possible for the machine to handle a wide range of miscellaneous work for facing, tapping and drilling operations.

The machines are designed for heavy and rapid boring, drilling, facing and tapping and have ample capacity to drive high speed drills of their rated sizes to their limit of efficiency in steel. They can be used for boring and enlarging in steel and cast iron for which operations they are especially designed. Instantaneous change from drilling to reaming feed in the correct ratio is also provided.

Eight speed changes are provided which may be instantly made without stopping the machine. The drive is through a train of hardened alloy steel gears, running on high grade annular ball bearings, all enclosed in an oil-tight box. A minimum number of gears are running in mesh at any time. Twelve drilling and twelve reaming feeds are provided. The feed rack is of alloy steel as is the feed pinion which meshes with it and which is cut directly on the shaft. A large bronze worm gear with provision for securing uniform wear and a safety shear

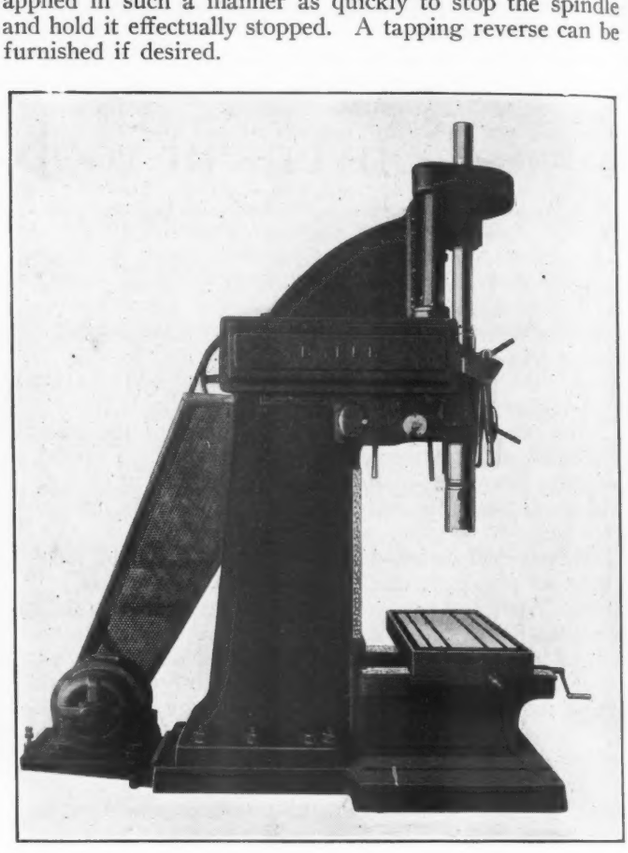
pin to protect the feeding mechanism from abuse are provided.

The spindle is of forged steel and is fitted with special chrome ball-thrust bearings. The spindle nose is bored for No. 6 Morse taper. It is slotted across the end for driving heavy boring and facing heads, fitted with a cross drift for holding these heavy tools securely and, in addition, has a hollow set screw to prevent the light tools from dropping out.

These machines have an automatic depth stop with fine adjustments. A special pair of feed change gears which may be applied at any time permits facing to an exact depth. It only requires a few seconds to apply these gears. Capstan handles are provided for rapid traverse; in addition, hand worm feed is provided.

The table, which is of the box-knee type, heavily braced and provided with unusually ample oil grooves, is raised and lowered by means of a telescoping screw. The construction is such that a 4-in. hole may be bored for supporting a boring bar of that diameter, the table being reinforced for this purpose. The bottom of the knee has the projecting edges planed parallel, permitting the use of parallel bars to take the thrust for extremely heavy work. The compound table is of the box-knee or heavy milling machine type. The adjustments are made by means of cut screws with a lead of one inch to the revolution. The operator can handle both movements simultaneously without changing his position. Furthermore, the screw adjustments may be quickly made. An ample oil pocket at each end with grooves at the sides and drainage takes care of the lubricant. The knee is bored and bushed for a lower boring bar support when desired.

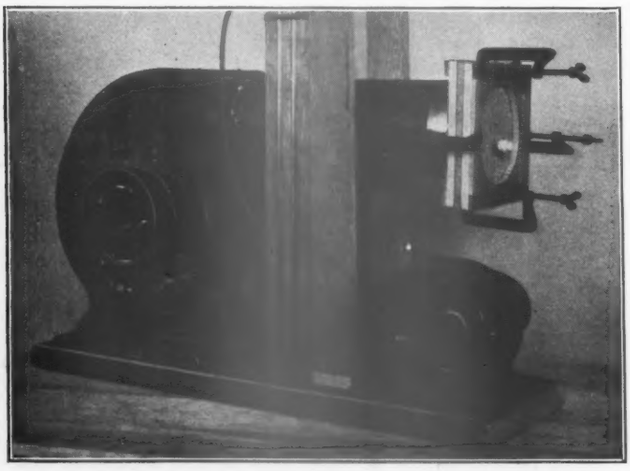
The machine can be arranged for driving direct from a motor and when so arranged, the sub-base is extended back and the motor is belted direct by means of a belt up to the machine driving pulley. The machine is started and stopped by means of shifting belt on tight and loose pulleys which run on ball bearings, a spring device holding the belt securely on or off. In the off position a brake is applied in such a manner as quickly to stop the spindle and hold it effectually stopped. A tapping reverse can be furnished if desired.



Baker 5-in. capacity vertical boring and drilling machine arranged for motor drive and equipped with a compound table

Balsam-wool insulation for refrigerator cars

AN insulator, called Balsam-Wool, made from the fibers of coniferous northern woods, chemically treated to withstand refrigerator car service has been placed on the market by the Wood Conversion Company, Cloquet, Minn. The fibers are first separated from one another by chemical and mechanical means similar to those used in pulp making. The individual fibers, which are fine, hairlike hollow tubes, are then saturated with chemicals that tend to render them both fireproof and decay proof. In this condition, they are next bound together with cement but with the axes of the fibers extending in all three cubical dimensions and not parallel to each other as in wood. The result is a resilient blanket of fibers which weighs only 5 lb. per cu. ft., or less than one-half the weight of cork. It contains countless still air cells, over 94 per cent of the volume being still air.



Testing equipment designed to determine the porosity of insulators

To increase the mechanical strength of the fibrous blanket, it is covered on both sides with a layer of creped waterproof Kraft paper which is cemented to the blanket of fibers by a high melting point asphalt. This covering layer is impervious to the passage of both water and air.

Tested for thermal conductivity, the average heat flow in 24 hours through Balsam-Wool is 6.1 B.t.u. per sq. ft. per in. thickness per deg. F., some samples testing as low as 5.7. The flexible texture of this product makes it elastic, and this elastic principle is further carried out through the use of the creped Kraft paper liner which it is said can be stretched 25 per cent or more without tearing. This is a greater stretch than occurs when the top of a refrigerator car weaves 8 in. out of line.

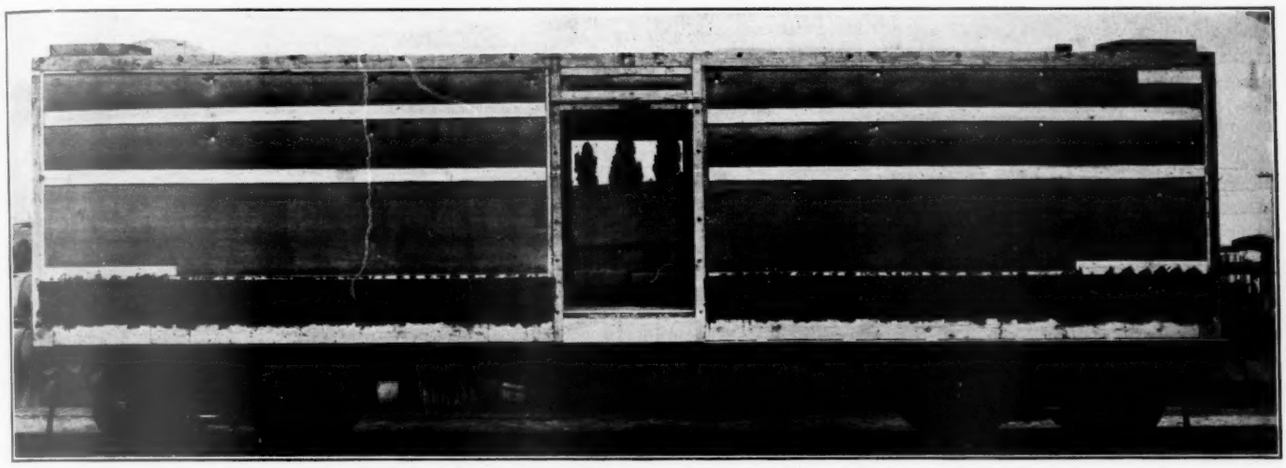
Some interesting tests of Balsam-Wool were conducted by Howard F. Weiss, research engineer of the C. F.

Burgess Laboratories, Madison, Wis., as follows: To test the resistance of the material to mechanical wear and tear, a machine was constructed on which was mounted a section of a refrigerator car side frame 8 ft. high and 4 ft. wide. To this section the insulators under test were then nailed. The machine was started and it thrust the top of the frame 8 in. out of plumb with the bottom. The whole frame at the same time being lifted and dropped 3/16 of an inch rapidly enough to give it a vibrating motion. The object sought was to duplicate as closely as possible what happens to an insulator fastened to a refrigerator car which is in bad condition and rolling over a rough track. After being subjected to many repeated thrusts and vibrations, the Balsam-Wool did not tear or shake down.

To test for porosity, an air pressure equivalent to an air velocity 40 miles an hour was maintained against one side of the insulator as illustrated, a manometer being used to indicate the pressure. The distance the cotton ball was blown from the perpendicular was used as a measure of the permeability of the insulator to air and in the case of Balsam-Wool there was no perceptible movement of the cotton ball. When inoculated with molds and fungus and placed in a warm, damp, atmosphere, no growth occurred.

The asphalt-coated liners are resistant to the passage of moisture so that the interior blanket of fibers is protected when exposed for an appreciable time to a high humidity. The tests showed that Balsam-Wool will absorb about 30 per cent moisture, or over twice as much as that of cork when subjected for a long time to a humidity of 90 per cent or more. However, at 30 per cent moisture, Balsam-Wool is said to contain less moisture per square foot than cork at 15 or 10 per cent moisture because of the former's extremely low density. Therefore, its thermal resistance, even when subjected to high and to prolonged humidity, is not seriously impaired by this condition.

The product comes in large sheets that are light in weight and can be easily cut and nailed. It is said to be possible to save 2,000 lb. or more of dead weight in the construction of a refrigerator car by the use of this insulation. About 20 cars have been equipped to date.

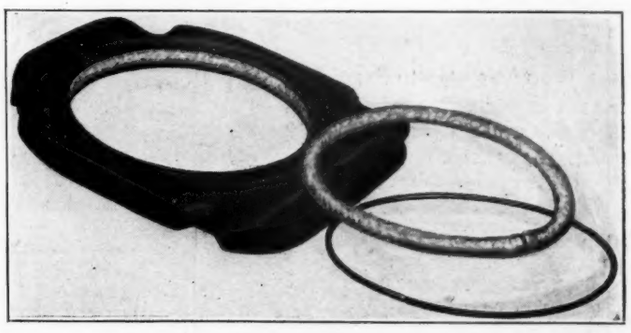


How Balsam-Wool insulation is applied to a refrigerator car

Journal box dust guard

A JOURNAL box dust guard manufactured in all sizes for freight and passenger equipment to conform to the American Railway Association standards has recently been placed on the market by the Union Asbestos & Rubber Company, Chicago. The purpose of the design is to maintain an oil-retaining and dust-proof joint around the axle and the side of the dust guard chamber.

Its construction differs somewhat from the usual design of dust guards. The two sides of the guard are pressed from steel sheets and securely spot welded together at four points. One side plate of the guard is so formed as to act as a spring and forces the opposite side tightly against the oil and packing retaining wall of the journal box. This arrangement provides a dust-proof joint between the dust guard and the side of the dust guard chamber and makes it self-supporting in the box, eliminating continuous and uneven wear at the top of the bore of the guard, as is the case where it rides on the axle. A special asbestos packing ring, inserted in the groove formed in the guard, is automatically held in close contact with the axle at all points on its circumference by means of a circular steel spring.



Dust guard pressed from steel sheets—An asbestos packing ring is used

Compact high speed electric hoist

A COMPACT, high speed electric hoist has been added to its line of products by the Roeper Crane and Hoist Works, Reading, Pa. The worm is placed above the gear. This is the reverse of the usual worm gear drive on most tools and is said to remove the cause of considerable wear. The worm shaft is equipped with a ball end thrust bearing.

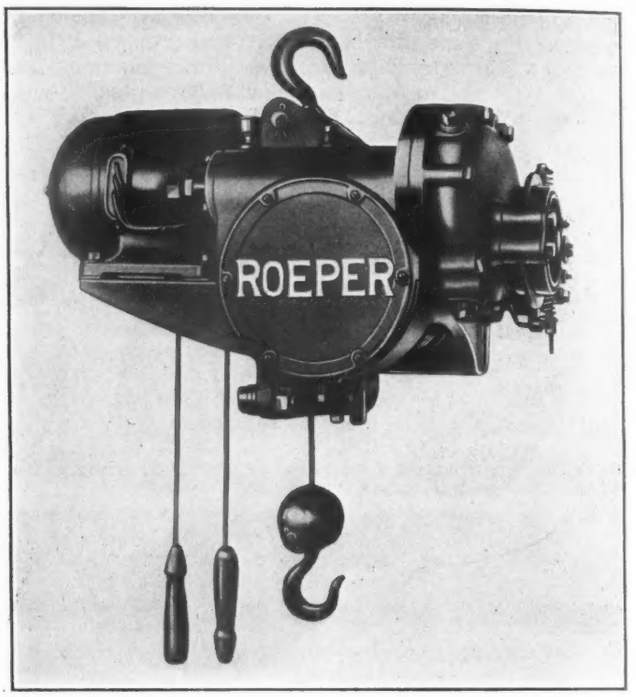
The motor is mounted on its feet directly upon an extension of the hoist frame. The main frame of the hoist is a one-piece casting that contains all the bearings so that shafts and moving parts, once assembled, cannot get out of alinement.

Steel suspension plates, reaching from the drum shaft to the overhead suspension members, relieve all tension on the castings and provide a means for a hook, link, clevice or any special form of suspension. An automatic stop of the trip lever type, positive in its action, affords protection in extreme lifting and lowering. This stop can be adjusted for any distance of hook travel.

The need of a load brake is removed by the worm drive. The motor is equipped with a mechanically operated jaw brake acting in series with the controller, which brings the motor to a quick stop, preventing drifting of the load when the power is cut off.

The controllers are of the single-speed drum type of standard design. For this control, the motor is equipped with an electric magnetic brake and an adjustable upper and lower electric limit switch.

While the illustration shows a hoist for hook suspension, it can also be furnished with either plain or geared I-beam trolleys with roller bearing wheels. Provision is also made for direct connection of the hoist to any standard trolley for a flat rail or a special track. The hoist can be furnished in 500, 1,000 and 2,000 lb. capacities with a single strand of hoisting cable.



Roeper Type R electric hoist with the worm gear placed above the gear

Alternating current motor drive for planers

IT is now generally acknowledged that driving a planer by a direct current adjustable speed motor connected directly to the machine is superior to any type of drive through belts or clutches. This is because of the higher cutting and return speeds possible, the ease with which any cutting or return speed may be obtained, accuracy of reversal and lower maintenance cost of the reversing motor drive.

Rear view of a planer showing the reversing driving motor and motor generator set with separate excitor

The advantages of the reversing motor drive for planers have, until recently, been confined to plants having a supply of direct current. It is now possible for the plant which has only alternating current available to obtain a reversing motor drive. The equipment by which this is accomplished comprises a direct current adjustable speed reversing motor connected directly to the planer, current for which is furnished by a generator driven by a motor which uses the alternating current from the main line. The connections between the planer motor and the generator are never broken when in use, therefore a controller with a multiplicity of relays and contactors for carrying the large armature current is not required. The entire control of the planer motor for direction and speed is obtained by manipulation of the small field current of the generator. Reversal of the field current of the generator changes the direction of the generated current and hence reverses the direction of rotation of the planer motor. The reversal of the generator field is effected by an oscillating drum switch operated by dogs on the table, the contacts being closed and opened under oil in the enclosing case.

Changes in speed of the planer motor are obtained by varying the field current of the generator; reducing the field current lowers the voltage of the generated current

and hence lowers the speed of the planer motor; increasing the field current raises the voltage and the speed of the planer motor is increased. The changes in field current are obtained through separate rheostats adjusted by hand for the cutting and return strokes; any cutting speed may, therefore, be used with any return speed within the range of the equipment. The generator and driving motor are mounted on one base and may be placed in any convenient location as the only connection between the generator and the planer driving motor is by wire. With this equipment, cutting speeds from 25 to 60 ft. per min. and return speeds as high as 160 ft. per min. can be obtained. Cutting speeds below 25 ft. can be obtained if necessary.

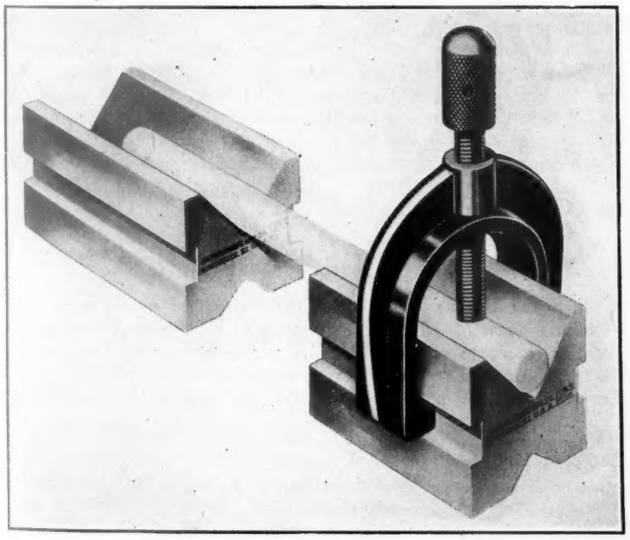
Failure of line voltage is liable to occur at any time from various causes. If the line voltage fails, the generator will continue to run for a short time because of its momentum, but since the control is effected through the generator field circuit, the planer will be reversed as usual until the whole system gradually comes to rest. Stops at each end of the table prevent accidents caused by the operator failing to fasten the reversing dogs.

The equipment includes a safety pendent switch suspended from a swivel on the arch or crosstie of the planer by a flexible cable which enables the operator to keep the switch close at hand when working. The entire control of the table motion, starting, stopping, reversing or jogging by very small fractions of an inch, is obtained by the single knob on this switch without requiring the operation of any other devices. The machine when running may be stopped instantly by pushing the knob upward.

This equipment has been placed on the market by the Niles-Bement-Pond Company, New York.

A pair of useful V-blocks and clamp

THE pair of V-blocks and clamp shown in the illustration are particularly useful for holding circular pieces to be drilled, milled or ground. They hold the piece



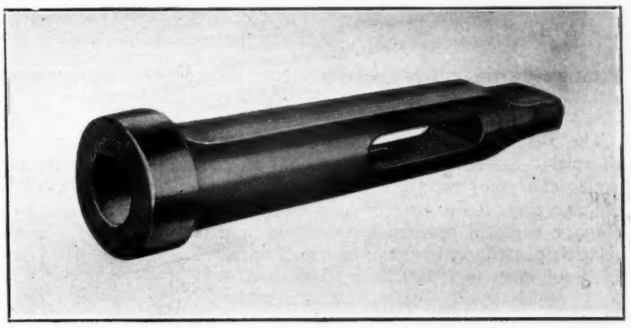
Method of using V-blocks and clamp

firmly and prevent it from turning or slipping while the work is being done.

The blocks are made of cast iron and are intended for general machinist's use. They are carefully finished and the grooves on the sides of the blocks are accurate. Each block is 2 in. long by 1½ in. square and will hold work up to 1½ in. in diameter. They are made by the Brown & Sharpe Manufacturing Company, Providence, R. I.

Improved sleeve for holding drills and reamers

WHEN drilling or reaming holes it is often necessary to use two or more sleeves when the tool used has a small shank. When the Lovejoy Tool Works, Chicago, redesigned its original drill sleeve they had this point in mind. The new sleeve is flattened on the

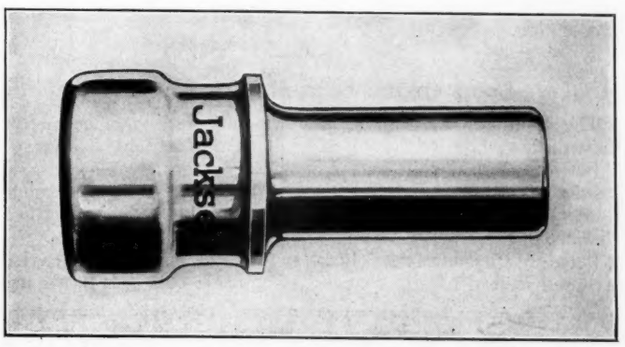


Drill sleeve designed for nesting

outside so that the sleeves can be nested. It also has a strong re-enforcement at the lower end of the sleeve which is claimed to make it much stronger than the original design. The inside and outside dimensions are practically the same as the standard Morse drill sleeve.

Triple service alloy steel rivet sets

THE life of a rivet set is determined by the number of rivets it will drive before it breaks. The Ingersoll-Rand Company, New York, has recently placed on the market a rivet set for pneumatic hammers which is said to



Ingersoll-Rand alloy steel rivet set

have shown a great increase in rivets driven per set over other types previously manufactured by this company. It is made of alloy steel which will stand a great degree of heat from hot rivets without the temper becoming drawn. It is specially forged and then heat treated by a new process.

General News

Damage estimated at $500,000 was caused by a fire at the shops of the Canadian National at Bridgewater, Nova Scotia, recently. Most of the buildings, together with eight locomotives, a number of freight cars and a large quantity of stores were destroyed. The buildings consumed included the roundhouse, machine shop, car shop, boiler shop, master mechanic's office and some smaller buildings. Some damage, too, was done to the station on the opposite side of the tracks. Seven of the eight locomotives destroyed were serviceable, and the eighth was undergoing repairs.

Pennsylvania places orders for passenger equipment to cost $6,000,000

The Pennsylvania has placed orders for 357 passenger cars of all steel construction, to be delivered as soon as equipment companies can complete their construction. The orders call for 222 baggage cars, 105 passenger coaches, 15 combination passenger and baggage cars, 10 combination baggage and mail cars and 5 combination passenger, baggage and mail cars. The estimated cost of this equipment is $6,000,000.

Locomotive inspection, first six months of 1925

During the first six months of 1925, 40,321 locomotives were inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission, of which 18,151 were found defective and 1,910 were ordered out of service, according to the Commission's monthly report to the President on the condition of railroad equipment. During June 7,381 locomotives were inspected, of which 3,044 were found defective and 292 were ordered out of service. The Bureau of Safety during the same month inspected 95,215 freight cars, of which 2,709 were found defective, and 2,011 fuel oil showed an increase. The average cost of fuel for road locomotives in freight and passenger train service (charged to operating expenses) for Class I steam railways in April was $2.79 a ton, as compared with $3.19 last April and $2.81 for four months of this year. There was also a reduction in the number of tons used, and the total cost for the month was $20,532,551. The average cost of fuel oil was 3.29 cents per gallon, as compared with 2.80 cents last April and 3.11 cents for four months. The total passenger cars, of which 23 were found defective. During the month 16 cases, involving 32 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

Long engine runs on the Southern

The Southern Railway is now running passenger locomotives long distances on a half dozen of its main lines, as follows:

Between Washington and Atlanta, 637 miles, two engines instead of four, changes being made at Spencer, N. C., the changes formerly made at Monroe, Va., and Greenville, S. C., having been eliminated.

Between Cincinnati and Jacksonville, 840 miles, three engines are used instead of six, changes being made only at Chattanooga and Macon. Formerly engines were also changed at Somerset, Atlanta and Valdosta.

Between Cincinnati and New Orleans, 836 miles, three engines are used instead of five, changes being made only at Chattanooga and Meridian. Engines are also being run through without change between Bristol, Va., and Chattanooga, Tenn., 242 miles; Chattanooga and Memphis, 314 miles; Atlanta, Ga., and Columbus, Miss., 290 miles; Louisville, Ky., and St. Louis, Mo., 274 miles; and Rome, Ga., and Meridian, Miss., 300 miles.

I. C. C. requested to provide an accounting system which will show true car repair costs

On July 14 a communication was addressed to the members of the Interstate Commerce Commission by seventeen representative members of the freight car repair industry, criticising the decision of the Commission relative to the contracting of equipment repairs by the railroads which it rendered on the basis of an investigation instituted early in 1921. It was claimed that the report of the inquiry made in 1921 did not present all of the essential information pertaining to car repair contracts, and that full hearings had not been conducted, although the report inferred that such had been the case. Furthermore, the system of accounting used by the railroads, which was approved by the Commission, did not show the actual car repair costs as overhead costs were not included.

The representatives of the freight car industry presented twelve factors which they considered to be sufficiently important to merit consideration by the Commission, some of which are as follows:

That the main business of railroad companies is transportation, which is a special occupation requiring special training, and is, in its fundamentals, as foreign to manufacturing as the latter is foreign to transportation. Railroad shops have no spur of competition but have a substantial monopoly of a railroad's work. Railroad accounts cannot show, and do not show, proper manufacturing costs, and are not a useful factor in controlling manufacturing costs, for if existing railroad accounts had contained proper and informative manufacturing data, it would not have been necessary for the Commission to make a special study of the cost for the investigation in 1921. That the Commission's decision that railroad overhead costs could be entirely disregarded was contrary to common reason and scientific principles of accounting. That the duplication of facilities afforded by both a railroad and car repair industry is an economic waste. That no conclusion applicable to the car industry as a whole can be justly drawn from isolated instances. That no proper comparison can be made unless it takes into consideration the relative speed of the delivery of the work performed.

Wage statistics for April

Class I railroads reported to the Interstate Commerce Commission a total of 1,745,643 employees as of the middle of April, 1925, an increase of 23,368, or 1.4 per cent over the returns for the previous month. The maintenance of way group shows an increase of 40,710 employees, but this increase is offset somewhat

Freight Cars Installed and Retired

Month 1925	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
January	11,768	551,263	7,867	326,812	2,341,109	103,812,974	5,285
February	15,024	721,867	9,453	365,111	2,346,687	104,169,525	4,878
March	16,007	753,947	12,057	474,644	2,350,697	104,454,128	5,572
April	13,749	652,462	10,497	423,322	2,353,956	104,683,798	8,072
May	12,982	612,607	8,658	335,401	2,356,641	104,902,235	9,042
Total for 5 months	69,530	.....	.....	.....	.....	.....	.....

Figures as to installations and retirements prepared by Car Service Division A. R. A. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

by decreases in the maintenance of equipment and transportation groups. Notwithstanding the net increase in the number of employees, the total compensation, $234,808,094, shows a decrease of $3,368,830, or 1.4 per cent, which resulted principally from a decrease in the number of hours worked per employee.

Compared with the returns for the same month last year, the employment in April, 1925, shows a decrease of 2.3 per cent and the total compensation a decrease of 0.9 per cent. The average straight time earnings per hour for all employees reported on an hourly basis increased from 57.4 cents per hour in April, 1924, to 58.2 cents in April, 1925.

Foreign railway news

Motive power and rolling stock on the Italian State Railways during 1924 was improved by the addition of 40 steam and 147 electric locomotives, six passenger cars, one baggage car, and 417 freight vehicles for the standard gage lines. During the year, 116 steam locomotives were withdrawn from service, and 707 passenger cars, 202 baggage and mail cars, and 4,463 freight cars were retired.

Sixty locomotives and 20 tenders for the Czechoslovak Railways will be purchased shortly, according to an announcement by the Ministry of Railways. The Ministry of Finance has been requested to provide the necessary funds, and the appropriation is expected to be made available this month. It is understood, however, that only Czechoslovak manufacturers will be invited to submit bids.

The Polish government will order for its railways rolling stock to cost $7,000,000, including 4 locomotives, 3,000 freight cars and 100 passenger cars and $4,200,000 worth of rails, switches and signal apparatus. The railways will also spend $7,200,000 on improvements to car shops, for which considerable new material will be purchased.

The liberal investment of the German railways in new equipment during the inflation period is now being reflected in abnormally low orders for locomotives and other rolling stock by the railway board established under the Dawes plan, according to Commercial Attaché Herring, at Berlin. According to most observers the German railways at the end of 1923 were in excellent condition, apart from the abnormal deterioration under the Franco-Belgian Régie during the Ruhr occupation. There is, therefore, considerable uneasiness now in German rolling-stock plants because of the tendency of the railway administration to limit new orders drastically. Only 80 locomotives are to be ordered during the current year, and there will be a corresponding reduction in contracts for spare parts and other equipment, except material for track building. The situation is not as serious as it might be, however, because such large companies as the Allgemeine Elektricitaets-Gesellschaft and the Borsig and Krupp works, which manufacture a large variety of products, are able to divert some of the labor employed in rolling-stock shops to other branches of their plants and otherwise adapt themselves to the situation. The fact remains, however, that even with reduced production, pressure on export markets will be greater, and there will doubtless be a more pronounced tendency to underbid American and foreign manufacturers—dumping German stock at sacrifice prices and compensating by price increases in lines where the domestic or foreign market, or both, is better able to absorb German goods.

Woman invents sleeping car of unique design

Mrs. Agnes R. Rossman, Scotch Plains, N. J., has recently designed and received patents on a sleeping car which is a real innovation in sleeping car architecture. The lower berths are so designed to insure perfect privacy. The berth, when made up, is enclosed by rolling steel curtains which are locked on the inside by the occupant. A private dressing room with a toilet and wash basin, is provided for each lower berth. They are arranged two rooms together with a connecting door. The dressing room doors leading to the aisle are provided with a shoe bin with a glass in it so that the porter can see whether or not they contain shoes. The porter can open the bin from the outside by a master key. These doors also contain an exhaust blower fan which is controlled by a two-stay switch. The fans can be used for blowing the air from the dressing room and lower berth or for drawing fresh air into these rooms. This arrangement maintains perfect ventilation. Each car is provided with two shower baths, one with each private dressing room of the berths at each end of the car. The lower berths are so designed that if the passenger is tall, the berth can be extended six or eight inches, thus providing ample space for the occupant.

The upper berths are easily accessible by means of a permanent folding stairway which the occupant can place in position without calling a porter. Along the edge of each upper berth runs a safety rail which protects the passenger from falling out. These berths have tight fitting sliding curtains independent of the lower berth which may be fastened on the inside, insuring privacy. The upper berths are provided with a luggage closet over the private dressing rooms of the lower berths, accessible through two doors, one opening into the upper berth and the other to the aisle. This closet provides ample space for luggage, facilities for hanging up clothing as well as trays, racks, etc., for toilet articles, a rack for a thermos bottle, a mirror for dressing and space for shoes.

In the day time this car has practically the same appearance as the present day Pullman. The occupants of the private berths have the advantage of seeing out both sides of the car, which is not obtainable in a compartment car.

Meetings and Conventions

Tool Foremen's Association to meet in Chicago

The American Railway Tool Foremen's Association will hold its thirteenth annual convention at Hotel Sherman, Chicago, on September 2, 3 and 4. H. T. Bentley, general superintendent of motive power of the Chicago & North Western, will deliver the opening address. G. T. Martin, assistant to general superintendent of motive power of the Chicago, Milwaukee & St. Paul, will speak on "The Tool Foreman's Responsibilities," and E. L. Woodward, western mechanical editor of the Railway Age, will present a paper on "The Importance of the Tool Room." Committee reports will deal with the following subjects: Standardization of tools in the locomotive and car shops; grinding in the railroad shops; jigs and devices for the locomotive and car shops; forging machine dies; machine tool equipment for the tool room, and economies possible by standardized small tools. An exhibit of machine and hand tools in connection with the convention will be displayed by the Supply Association of the American Railway Tool Foremen's Association.

New York Railroad Club outing

The New York Railroad Club held its second annual outing, or mid-summer festival, at the New York Athletic Club, Travers Island, and at the Winged Foot Golf Club, Mamaroneck, N. Y., on Thursday, July 9. Over 200 golfers went to the golf club early in the morning. A special train left New York for Travers Island at noon. The Long Island Railroad Band played en route and headed the procession in the march from the station at Pelham Manor to Travers Island. A buffet luncheon and dinner were served at the clubhouse and the party returned to New York on a special train late in the evening.

Among the various forms of relaxation which were a part of the outing were a number of competitive sports in which prizes were awarded. These included a golf tournament at the Winged Foot Golf Club and a tennis tournament and track meet at Travers Island in the afternoon. A variety of prizes was offered in the golf tournament covering low gross, low net, "kicker's" handicap, and others, the winners of prizes being as follows: D. D. Cooke, American Locomotive Company; C. E. Bryant, Johns-Manville, Inc.; G. H. Weiller, American Locomotive Company; H. M. Behre, Surety Engineering Company; L. O. Smith, Columbia Machinery Works; C. G. Melvin, Galena Signal Oil Company; W. J. Fripp, general manager, New York Central; C. C. Hubbell, purchasing agent, Delaware, Lackawanna & Western; C. L. Bardo, formerly general manager, New York, New Haven & Hartford; Frank Hedley, president, Interborough Rapid Transit, and A. N. Dugan, Bronze Metal Company.

The results of the track meet were as follows: 100-yd. dash won by E. Dunbar, Pennsylvania System, 10⅗ sec.; 220-yd. dash won by S. Marion, Erie Railroad, 24⅖ sec.; first 440-yd. race won by H. Higgins, Safety Car Heating & Lighting Company, 54 sec.; second 440-yd. race won by J. F. Mitchell, Interborough

Rapid Transit, 54 sec.; 880-yd. run won by G. C. Gault, Safety Car Heating & Lighting Company, 2 min. 5⅘ sec.; one-mile relay race for company teams won by the Safety Car Heating & Lighting Company, 3 min. 30 sec., with the Erie, second, and the Interborough team, third.

In the tennis tournament, the singles were won by R. P. Spooner, American Abrasive Metals Company, with Harry Doyle, runner-up. The doubles tournament was won by Harry Doyle and C. C. Willetts. Other special features were a soft ball baseball game between the railroad men and the railway supply representatives, swimming and quoits. Scott Donahue was chairman of the General Committee. J. S. Doyle, superintendent of equipment, Interborough Rapid Transit Company, was director of sports and entertainment.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 15, 16 and 17, 1925, at St. Paul Hotel, St. Paul, Minn.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 2-4, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Stebing, Bradford Corp., 25 West Forty-third Street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27 to 30, inclusive, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth street, Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt Street, New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual convention Hotel Sherman, Chicago, September 22-24.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August at 29 West Thirty-ninth Street, New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth Street, Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison Street, Chicago. Regular meetings third Monday in each month, except June, July and August.

Supply Trade Notes

Thomas J. Hyman, secretary and treasurer of the Illinois Steel Company, Chicago, died on July 5.

Charles T. Westlake, chief mechanical engineer of the Commonwealth Steel Company, St. Louis, Mo., died on July 22.

L. J. Ferderber has been appointed assistant to the first vice-president of the General American Tank Car Corporation, Chicago.

S. H. Worrell has been appointed district sales manager of the Detroit Seamless Steel Tube Company, with headquarters at Detroit, Mich.

T. V. Buckwalter, chief engineer of the Timken Roller Bearing Company, Canton, Ohio, has been elected vice-president in charge of engineering.

The Ajax Manufacturing Co. has removed the Cleveland, Ohio, office to its new plant on Chardon road near Euclid avenue, Euclid, Ohio, a suburb of Cleveland.

Carl A. Methfessel, manager of sales of the eastern district of the Duff Manufacturing Company, New York, died on July 22 at his home in Ridgefield Park, N. J.

Edward Payson Bigelow, sales agent for the American Steel Foundries Company, New York, died on July 20 at his home in New York from apoplexy, at the age of 81.

H. E. Passmore, formerly salesman of the Grip Nut Company at Columbus, Ohio, has been appointed sales manager of the Davis Brake Beam Company, Pittsburgh, Pa.

The National Forge Company, Louisville, Ky., has appointed E. H. & R. W. Benners as its representative in New York, for the sale of its knuckle pins and "S" and "Z" irons.

E. P. Blanchard, advertising manager of the Bullard Machine Tool Company, Bridgeport, Conn., has been appointed also assistant sales manager, with headquarters at Bridgeport.

Herbert G. Cook has been appointed Pacific Coast representative of the Railway Steel-Spring Company, New York. Mr. Cook's headquarters are at 582 Market street, Hobart building, San Francisco, Cal.

L. W. Grout, vice-president and sales manager of the Keating Valve Company, Springfield, Mass., for the past three years, has joined the sales organization of the Bridgeport Brass Company, Bridgeport, Conn.

H. E. Passmore has been appointed sales manager of the Davis Brake Beam Company, with headquarters at 1602 Oliver building, Pittsburgh, Pa. Mr. Passmore was formerly in the employ of the Grip Nut Company.

The E. L. Essley Machinery Company, Chicago, has been appointed exclusive agent for the Buffalo Forge Company, Buffalo, N. Y., to sell punches, shears, bar cutters, slitting shears and beam shears in Chicago territory.

The Ypsilanti Foundry Company, Ypsilanti, Mich., manufacturers of piston rings, has awarded a contract for a new machine shop to the Austin Company, Chicago. The building will be a two-story structure, 50 ft. by 100 ft.

Otis B. Duncan, 53 West Jackson boulevard, Chicago, has been appointed representative for the Chicago territory of the Johnston Manufacturing Company, Minneapolis, Minn., manufacturers of industrial oil-burning equipment.

The Johnston Manufacturing Company, Minneapolis, Minn., manufacturers of industrial oil-burning equipment, has appointed Otis B. Duncan, 53 West Jackson boulevard, Chicago, as representative for the Chicago territory.

C. W. Moore, 1523 Candler building, Atlanta, Ga., is representing the Goddard & Goddard Company in the southeastern territory covering North Carolina, South Carolina, Georgia, Florida, Alabama and Tennessee west to the Tennessee river.

Walter T. Comley has been elected vice-president in charge of service and production, and Adam P. Arnold, secretary and treas-

urer of the Franklin Railway Supply Company, Ltd., of Montreal, Canada. Leland Brooks, vice-president and treasurer, has resigned.

A sales and service branch office has recently been opened by the DeVilbiss Manufacturing Company, Toledo, Ohio, at 4614 Woodward avenue, Detroit, Mich., where a display and stock of the complete DeVilbiss spray-painting equipment will be carried at all times.

The American Manganese Steel Company has opened a new plant at Los Angeles, Cal., which gives the company facilities for producing about 25,000 tons of manganese steel castings annually. The new plant will begin production at the rate of 100 tons a month.

J. C. Dawes, formerly with the Weldcraft Company, Pittsburgh, Pa., has been appointed a sales representative at the Pittsburgh branch of the International Oxygen Company, Newark, N. J. L. W. McCullough has been appointed sales representative for the branch at Toledo.

C. W. Marshall has been appointed eastern sales manager of the Sunbeam Electric Manufacturing Company, Evansville, Ind. Mr. Marshall will have his office in the Grand Central Terminal, New York. He was formerly Chicago district manager of the American Arch Company, New York.

The Union Tank Car Company has awarded a general contract to the Hughes-Foulkrod Company, Pittsburgh, Pa., for a car construction, repair and conditioning plant at Whiting, Ind., including a foundry, machine shop, power plant, wheel shop, and other structures; to cost approximately $1,700,000.

R. L. M. Taylor has been appointed district sales representative of the New York State and Eastern Pennsylvania territory, known as the Reading district of the Reading Iron Company, Reading, Pa. Mr. Taylor joined the Reading Iron Company one year ago, after serving for five years with the A. M. Byers Company.

The Dempsey Furnace Company, Jersey City, N. J., has been consolidated with the W. N. Best Corporation, 11 Broadway, New York City. The combined furnace business of the two companies will in future be operated as the Dempsey furnace division of the W. N. Best Corporation under the personal direction of H. B. Dempsey.

Charles E. Miller has been appointed representative in the Chicago district of the Premier Staybolt Company, Pittsburgh, Pa., succeeding L. W. Widmeier, resigned. The Chicago office of the company is now located at 548 Railway Exchange building. C. S. Carter has been appointed northwestern representative, with office at 752 McKnight building, Minneapolis, Minn.

B. A. Tozzer, manager of the Cleveland office of the Niles-Bement-Pond Company, New York, has been appointed sales manager of the New York office. A. E. R. Turner, in charge of the office at Walkerville, Can., succeeds Mr. Tozzer at Cleveland. Sydney Buckley, chief engineer at Philadelphia, Pa., has been appointed works manager of the crane works at Philadelphia, to succeed V. O. Strobel, resigned.

Raymond B. Hosken, assistant to the vice-president in charge of sales of the Sullivan Machinery Company, Chicago, has been promoted to general sales manager. He entered the employ of the Sullivan Machinery Company in the local sales department in Chicago after graduating from the University of Michigan in 1910. In 1914 he was promoted to Australasian manager, with headquarters in Sydney, N. S. W., and in 1921 he was promoted to assistant to the vice-president in charge of sales at Chicago, which position he held until his recent promotion.

Henry S. Mann, for many years district manager in charge of the Chicago office and shops of the Metal & Thermit Corporation, has resigned to become district sales manager of the Standard Stoker Company, Inc., New York. Mr. Mann will have his headquarters in the McCormick building, Chicago. Previous to entering the service of the Metal & Thermit Corporation he had been connected with a number of railways, serving as a locomotive engineer with the Boston & Maine, the Northern Pacific, the Atchison, Topeka & Santa Fe and the Wabash. He has served as a director of the National Railway Appliance Association of Chicago; vice-president of the American Welding Society and vice-president of the International Railroad Master Blacksmiths' Supplymen's Association.

W. D. Horton, western railway representative of the Murphy Varnish Company at Chicago, has been appointed manager western railway sales, with headquarters at 50 West Twenty-second street, Chicago. From 1908 to 1914 he was associated with the Railway Age as traveling subscription representative and on April 1, 1914, was appointed circulation manager, which position he held until March 1, 1919, when he resigned to go as district railway sales manager to the Patton Paint Company. On December 1, 1919, he resigned to become associated with the Murphy Varnish Company as western railway representative, which position he held until his recent promotion. Mr. Horton has had a wide selling experience, having spent several years previous to 1908 selling various commodities, such as stationary engines, boilers, woodworking and other machinery. In this work he traveled extensively in North America, the West Indies and in Central and South America.

John F. Schurch, vice-president of Manning, Maxwell & Moore, Inc., has been elected president to succeed John M. Davis, who has resigned to become president of the Delaware, Lackawanna & Western. Mr. Schurch graduated from the University of Minnesota in 1893. The same year he entered the service of the Minneapolis, St. Paul & Sault Ste. Marie, where he served consecutively in the office of the auditor, the general superintendent and in the transportation department, resigning in 1905 after having attained the position of chief clerk to the vice-president. He was then associated with the Railway Materials Company of Chicago until February, 1914, when he was elected vice-president of the Damascus Brake Beam Company, with office in Cleveland, Ohio. The following June he was elected president of the same company, which position he resigned later in the same year and was elected vice-president in executive charge under President T. H. Symington, of the T. H. Symington Company. In June, 1922, Mr. Schurch left the Symington Company to become a vice-president of Manning, Maxwell & Moore, Inc., in charge of sales in the middle west and the west, with headquarters in Chicago. Mr. Schurch served in 1922 as president of the Railway Supply Manufacturers' Association, which had in charge the exhibits at Atlantic City in connection with the meetings in June of Division V—Mechanical, and Division VI—Purchases and Stores, A. R. A.

J. F. Schurch

Master blacksmiths to visit machine tool exposition

An invitation to attend the second exposition of forging machines and bolt and nut machinery which is being held at the plant of the National Machinery Company at Tiffin, Ohio, August 21 to 26, inclusive, has been extended to the International Railroad Master Blacksmiths' Association, which is holding its annual convention in Cleveland, Ohio, August 18, 19 and 20. The first day of the exposition, Friday, August 21, has been set aside as master blacksmiths' day. A large part of the work to be demonstrated will be of special interest to members of the Blacksmiths' Association, and special arrangements have been made for the transportation by special train of the members and their families between Cleveland and Tiffin.

This exposition is the second of its kind to be conducted by the National Machinery Company. The first was held 15 years ago. It is planned to have a total of 62 machines, many of which are of new design, tooled up and in operation. The exhibit will contain a complete line of the National Machinery Company's forging machines, each of which will be in actual operation on various kinds of forging work. There will also be a complete nut and bolt plant in operation, in which will be shown a number of designs which have recently been developed.

Trade Publications

PULLEY GRINDERS.—Circular F descriptive of a new pulley grinder designed for finishing the face of belt surface of metal pulleys from the rough after chucking the holes, has been issued by the Graham Manufacturing Company, Providence, Rhode Island.

THE DRILL FOR TODAY.—In a 16-page pamphlet the Detroit Twist Drill Company, Detroit, Mich., presents an account of the conditions leading to the development of the rolled type of twist drill. It is an interesting story containing much information of value to the user of drills.

WHAT RUST CAN DO.—The Detroit Graphite Company has issued a folder showing various types of structures exposed to the elements and emphasizing the deterioration that occurs unless they are properly protected, setting forth the merits of its Degraco paint for this purpose.

GRINDING AND POLISHING MACHINES.—The Builders Iron Foundry, Providence, R. I., and its associate, the Diamond Machine Company, have issued a catalogue descriptive of a new line of belt and motor-driven ball bearing grinders and polishing machines and swing frame grinders.

LEDRITE ROD-O-GRAPH.—The second edition of the Ledrite Rod-o-graph, which provides in chart form a convenient way to figure the weight of brass rod required to make 1,000 screw machine parts to known dimensions, has been issued by the Bridgeport Brass Company, Bridgeport, Conn.

DODGE SHOP FACILITIES.—The engineering, foundry and machine shop facilities available for the manufacture of its special machinery and equipment are visualized in a book recently issued by the Dodge Manufacturing Corporation, Mishawaka, Ind. A wide range of special equipment is also shown.

WHEEL TRUING BRAKE SHOES.—A 12-page, illustrated brochure descriptive of the wheel truing brake shoe designed to remedy flat wheels, grooved tires, long flanges and deformities to which wheels are subject in both steam and electric service, has been issued by the Wheel Truing Brake Shoe Company, Detroit, Mich.

AIR COMPRESSORS.—The latest types of Tilghman air compressors and vacuum pumps are described and illustrated in Catalogue No. C25 which has recently been issued by the Tilghman's Patent Sand Blast Company, Ltd., Broadheath, Manchester, England. Air compressing plant design is also briefly described in this catalogue.

VISES.—A 56-page illustrated price list descriptive of the particular features of Prentiss vises, has been issued by the Prentiss Vise Company, New York. The new collar fastening for screws, designed to fasten the screw to the front jaw and then draw it out when the screw is turned to open the vise, is also illustrated and described.

GRINDING WHEEL STANDS.—The characteristic features of the Norton motor driven grinding wheel stands and specifications are given in a 20-page brochure which has been issued by the Norton Company, Worcester, Mass. The Norton combination protection and dust hoods, cylinder chucks and grinding wheel dressers are also briefly described.

REAL PRODUCTION TOOLS.—Under this title a series of illustrated booklets is being issued by the Goddard & Goddard Company, Detroit, Mich., describing the various types of special milling cutters and metal cutting saws manufactured by that company. A brief description of the types is supplemented by information as to the proper application to different classes of work.

ROTARY SHEARS.—Catalogue No. 80 describing in a comprehensive manner the various sizes and types of, and the different attachments provided for Quickwork shears and indicating how the machines operate and how the material is handled into them, has been issued by the Quickwork Company, St. Marys, Ohio. The catalogue is 9 in. by 11 in. and is attractively bound in leather, with gold lettering.

RECLAIMING SCRAP CAR AXLES.—The reclaiming of scrap car axles as practiced by a middle western railroad shop is described in an eight-page illustrated circular recently issued by the Ajax Manufacturing Company, Euclid, Ohio. The railroad referred to makes it a practice to centralize at one point and reclaim every scrap axle available from the entire system, the needs of the road with practically all except the largest size axles being supplied from this source.

STOKERS.—A two-page illustration showing the application of the Du Pont Simplex Type B stoker to a locomotive is contained in Bulletin No. 101, which has been issued by the Standard Stoker Company, New York. The stoker, which weighs approximately 5,800 lb., is simple in application, and the only stoker parts located on the backhead of the locomotive are the small distributing valves which may be located under the fire door opening, or any other place convenient to the fireman.

TRACTORS.—The operation and control of Elwell-Parker tractors, in general, is described in the first section of a 40-page illustrated catalogue, No. 140, which has been issued by the Elwell-Parker Electric Company, Cleveland, Ohio. Separate sections are then devoted to the special features and specifications for each of the haulage units, which include all electric motor-driven, rubber-tired industrial trucks, tractors, portable cranes or special types receiving their power from storage batteries carried on them.

PUSH BUTTON OPERATED OIL SWITCH.—Bulletin No. 1048, descriptive of a new push button operated oil switch for starting squirrel cage motors and also single phase motors, has been issued by the Electric Controller & Manufacturing Company, Cleveland, Ohio. This starting switch throws the motor across the line when the "start" button is released. It is arranged for no-voltage protection or no-voltage release, as desired, and provides overload and phase failure protection by means of expansion wire temperature relays.

AUXILIARY LOCOMOTIVE.—Catalogue H, descriptive of the operation, advantages, principal details and performance of the Bethlehem auxiliary locomotive, which is a tractor truck used as the rear truck of the locomotive tender, has been issued by the Bethlehem Steel Company, Bethlehem, Pa. This unit carries an auxiliary steam engine actuated by steam from the locomotive and controlled from the cab. Its function is to add more tractive force for starting, accelerating and operating at low speeds on heavy grades.

DIESEL ENGINE BUILDING.—Bulletin No. 1040, entitled "Modern methods in Diesel engine building," has recently been issued by Fairbanks, Morse & Co., Chicago, Ill. An attempt is made in this attractive 32-page bulletin to picture the present-day engineering refinements that enter into the construction of Diesel engines and what these refinements mean to the purchaser, each step in the process of manufacture of an engine, from the selection of the raw material to the final inspection and application of the finished product, being described.

HIGH SPEED TOOLS.—The Cleveland Twist Drill Company, Cleveland, Ohio, has issued its Catalogue No. 41 in a smaller and more comprehensive form. The catalogue contains 244 pages, so arranged as to make it a quick and ready index to the various high speed tools listed, which include drills, reamers, extractors, mills, counterbores, etc., and a few special tools. Several new tools, including special drills for Bakelite and slate, a small jobbers carbon drill set, a spiral fluted shank taper and several types of reamers, have been included in the catalogue.

CHEMICAL ENGINEERS.—Railroad men, both prospective and long-time users of Dearborn chemical service, will find much of interest in an attractively prepared booklet, "A House of Chemical Engineers," recently issued by the Dearborn Chemical Company, Chicago. For many years this company has been prescribing and blending the chemicals required to correct scaling, foaming, pitting, and corroding conditions in the boilers of locomotives and power plants operated by the railroads and other industries, thus conserving fuel and rendering more permanent the investments in power plant machinery. The booklet referred to contains 39 5½-in. by 8-in. pages and presents in attractive form a pictorial record of the Dearborn plant, its laboratories, storage tanks, manufacturing department and organization. Pictures of the officers of the company, beginning with Robert F. Carr, president, are included.

Personal Mention

General

E. VON BERGEN has been appointed general air brake, lubricating and steam heat engineer of the Illinois Central, with headquarters at Chicago.

JOHN R. JACKSON has been appointed engineer of tests of the Missouri Pacific, with headquarters at St. Louis, Mo., a newly created position.

E. A. KUHN has been appointed engineer of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, a newly created position.

F. J. HERTER has been appointed engineer of rolling stock of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio. This is a newly created position.

A. J. PICHETTO has been appointed air brake, lubricating and steam heat inspector of the Northern and Western lines of the Illinois Central, with headquarters at Chicago.

GEORGE B. HART has been appointed assistant to the general superintendent of motive power of the Southern Pacific, with headquarters at San Francisco, a newly created position.

G. M. WILSON, superintendent, motive power shops, of the Canadian National, with headquarters at Montreal, Que., has been transferred to Stratford, Ont., succeeding John Roberts.

T. W. KENNEDY has been appointed air brake, lubricating and steam heat inspector of the Southern lines of the Illinois Central and the Yazoo & Mississippi Valley, with headquarters at Memphis, Tenn.

W. B. EMBURY, master mechanic of the Armourdale shops of the Chicago, Rock Island & Pacific at Kansas City, Kans., has been appointed superintendent of motive power, with headquarters at El Reno, Okla.

A. MCDONALD has been appointed superintendent, motive power shops, of the Canadian National, with headquarters at Montreal, Que., succeeding G. M. Wilson. Mr. McDonald is 37 years of age. He was born at Stratford, Ont., and entered the service of the Grand Trunk in Stratford when he was 16. He was apprenticed to both the machinst and fitter trades, spending 7 years in acquiring both. On completion of his apprenticeship he served in those capacities until he was given a minor foremanship a few years later. In 1917 he was promoted to assistant superintendent of the shops at Point St. Charles. In 1919 he was appointed acting superintendent of motive power, Eastern lines, returning a short time later to his post as assistant superintendent at Point St. Charles, in which capacity he was serving at the time of his recent promotion.

J. F. JENNINGS, whose promotion to superintendent of motive power of the Michigan Central, with headquarters at Detroit, Mich., was reported in the May issue of the *Railway Mechanical Engineer*, was born on June 11, 1871, at Jackson, Mich. He entered railway service in September, 1891, as a locomotive fireman on the Lake Shore & Michigan Southern, now a part of the New York Central, and was later employed in a similar capacity on the Michigan Central. He was promoted to traveling fireman in February, 1903, and in January, 1904, was promoted to assistant traveling engineer. Mr. Jennings was promoted to road foreman of engines in May, 1905, and held that position until May, 1913, when he was promoted to assistant division master mechanic. He was promoted to division master mechanic at Bay City, Mich., in February, 1915, and held that position until October, 1919, when he was promoted to assistant superintendent of motive power. Mr. Jennings continued in that capacity until his recent promotion to superintendent of motive power.

FRANK H. BECHERER, who has been appointed assistant to the mechanical superintendent of the Boston & Maine, with headquartres at Boston, was born on August 23, 1882, in New York City. He graduated from high school in Indiana in 1901, and attended a Y. M. C. A. night school in Buffalo until 1906. He entered railway service in 1901, as a billing clerk on the Erie, and held this position until 1903, when he became assistant chief clerk of the car department. In 1904, he was promoted to piece work supervisor of the car department and, in 1905, to chief clerk of the department. On June 1, 1907, he resigned and went with the Pennsylvania as assistant chief M. C. B. billing clerk, and was successively until 1918, freight car repairer, freight car inspector, air brake inspector, piece work inspector of freight, traveling inspector for the superintendent of motive power, assistant foreman car inspector (freight), assistant foreman passenger cars, foreman passenger cars and foreman enginehouse, powerhouse and machine shop. On March 25, 1918, he resigned to enter the service of the Interstate Commerce Commission, Bureau of Valuation, as a junior inspector of car equipment. On October 1, 1919, he became senior mechanical engineer engaged in valuing freight, passenger, work, powerhouse and machine shop equipment and locomotives. On March 1, 1922, he resigned and entered the service of the Boston & Maine as assistant engineer, corporate engineer's office. On October 1, 1922, he became mechanical inspector, and in April, 1923, general inspector car maintenance, which position he held until June 16, 1925, when he was appointed assistant to the mechanical superintendent.

Master Mechanics and Road Foremen

W. A. KING has been appointed road foreman of engines of the Seaboard Air Line, with headquarters at Wildwood, Fla.

A. HAMBLETON has been appointed master mechanic of the El Paso-Amarillo division of the Chicago, Rock Island & Pacific, succeeding J. C. Cole.

R. R. HARRIS has been appointed road foreman of engines of the Tampa & Gulf Coast and the Tampa Northern, with headquarters at Tampa, Fla.

G. A. HASLETT has been appointed general road foreman of engines, Southern district, of the Seaboard Air Line, with headquarters at Tampa, Fla.

F. B. KESTER, master mechanic of the Chicago & North Western at Escanaba, Mich., has been appointed master mechanic, with headquarters at Antigo, Wis.

J. S. JONES, assistant master mechanic of the Chicago & North Western at Antigo, Wis., has been appointed master mechanic, with headquarters at Escanaba, Mich.

H. M. AGIN has been appointed road foreman of engines of the Florida division of the Seaboard Air Line, with headquarters at Tampa, Fla., succeeding G. A. Haslett.

E. H. CARLSON has been appointed assistant master mechanic of the Fargo division of the Northern Pacific, with headquarters at Staples, Minn., succeeding J. A. Marshall.

J. C. TRIGG has been appointed assistant road foreman of engines of the Florida division of the Seaboard Air Line, with headquarters at Waldo, Fla., succeeding H. M. Agin.

J. A. MARSHALL, assistant master mechanic of the Fargo division of the Northern Pacific at Staples, Minn., has been promoted to master mechanic of the Pasco division, with headquarters at Pasco, Wash.

J. C. COLE, master mechanic of the El Paso-Amarillo division of the Chicago, Rock Island & Pacific, with headquarters at Dalhart, Tex., has been transferred to Chickasha, Okla., succeeding A. R. Ruiter.

A. R. RUITER, master mechanic of the Chicago, Rock Island & Pacific, with headquarters at Chickasha, Okla., has been transferred to the Kansas City Terminal-St. Louis division, succeeding W. B. Embury.

H. J. MCCRACKEN, formerly district boiler inspector of the Northern district of the Southern Pacific at Sacramento, Cal., has been promoted to assistant master mechanic of the Western division, with headquarters at West Oakland, Cal.

W. B. EMBURY, master mechanic of the Kansas City Terminal-St. Louis division of the Chicago, Rock Island & Pacific, with headquarters at Armourdale, Kans., has been promoted to superintendent motive power of the Second district, with headquarters at El Reno, Okla.

Car Department

W. T. Westall has been appointed assistant district master car builder (Fourth district) of the New York Central, with headquarters at Air Line Junction (Campbell street shops), Toledo, Ohio.

E. B. Dailey has been promoted to engineer of car construction of the Southern Pacific, with headquarters at San Francisco, Cal. Mr. Dailey was born on February 1, 1870, in Omaha, Neb., and was educated at Creighton College, Omaha, Neb. He entered railway service in July, 1886, as a machinst apprentice on the Union Pacific at Omaha, and was later employed as a machinist on the Northern Pacific, the Oregon Railway & Navigation Company, the Union Pacific and the Southern Pacific. In September, 1892, he was employed as a draftsman on the Union Pacific at Omaha, later being promoted to inspector of equipment. He was promoted to chief draftsman in 1903 and was later promoted to assistant mechanical engineer. In February, 1913, Mr. Dailey was appointed assistant to the director of purchases of the Southern Pacific at New York. On June 1, 1918, he was appointed first assistant manager of the Procurement section of the United States Railroad Administration at Washington, D. C. In September of the same year he returned to the Southern Pacific as corporate mechanical engineer of the lines in Texas and Louisiana. From March 1, 1920, to January 1, 1921, he was assigned to special work, on the latter date being again appointed assistant to the director of purchases of the Southern Pacific at New York. He held that position until his recent promotion to engineer of car construction.

E. B. Daily

Purchasing and Stores

A. G. Follette, supervisor of the stores catalog of the Pennsylvania, has been appointed assistant chief general material supervisor with headquarters at Philadelphia, Pa.

D. C. Curtis has been promoted to chief purchasing officer of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago. Mr. Curtis was born in 1878 at Remington, Ind., and entered railway service in 1898 as an office boy in the engineering department of the Chicago, Burlington & Quincy at Chicago. He was transferred to the mechanical department in 1899 and in 1904 was placed in charge of the piece work department. In 1907 Mr. Curtis was transferred to the stores department and was promoted to inspector of stores in 1909. He was promoted to traveling storekeeper in 1914 and held that position until 1919, when he was appointed supervisor of stores of the Northwestern region under the United States Railroad Administration. He was appointed general storekeeper, lines east, of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., in 1920, and held that position until his promotion to chief purchasing officer.

D. C. Curtis

W. B. Hall, whose promotion to general purchasing agent of the Denver & Rio Grande Western, with headquarters at Denver, Colo., was reported in the May issue of the *Railway Mechanical Engineer*, was born on March 7, 1877, at Salt Lake City, Utah. He entered railway service in 1891 as an office boy in the motive power and car department of the Rio Grande Western, now a part of the Denver & Rio Grande Western. He was later promoted to clerk, which position he held until 1895, when he was promoted to stationer. Mr. Hall was appointed a clerk in the stores department in 1899 and in the following year was promoted to chief clerk to the purchasing agent. He was appointed stationer of the Denver & Rio Grande, with headquarters at Denver, Colo., in 1903, and in 1905 was promoted to division storekeeper, with headquarters at Salt Lake City, Utah. Mr. Hall was promoted to general storekeeper in July, 1908, and held that position until his recent promotion to general purchasing agent.

W. B. Hall

N. M. Rice, general purchasing agent of the New York, New Haven & Hartford, at New Haven, Conn., has been elected vice-president in charge of purchases and stores, with the same headquarters. Mr. Rice was born on December 28, 1863, at Rome City, Ind., and was educated in the public schools of that city. He entered railway service in May, 1887, as a brakeman on the Gulf, Colorado & Santa Fe, and from this time until April 1, 1901, he held several positions in the transportation and stores department. From April, 1901, to April, 1903, he was assistant general storekeeper of the Atchison, Topeka & Santa Fe Coast Lines, at which time he became general storekeeper of the same road in charge of material, fuel and stationery. He held this position until November 13, 1913, when he was appointed general purchasing officer of the St. Louis & San Francisco, with headquarters at St. Louis, Mo. From 1915 to 1916, he was third vice-president in charge of purchases, and from 1916 to 1919, was second vice-president of the same road. From 1919 to 1920, he was vice-president of the Pierce Oil Corporation, and, in 1920, became general purchasing agent of the New York, New Haven & Hartford, and also of the Central New England and New England Steamship Company.

N. M. Rice

Shop and Enginehouse

J. D. Bumcrots, lead machinist in the back shop of the Kansas City Southern at Pittsburg, Kans., has been appointed to the newly created position of shop efficiency supervisor.

John Roberts, superintendent, motive power shops, Canadian National, at Montreal, Que., has been appointed general supervisor of shop methods, with headquarters at Montreal, a newly created position.